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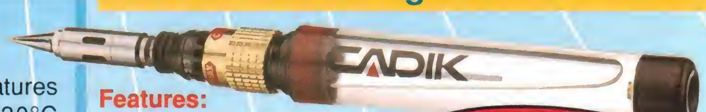

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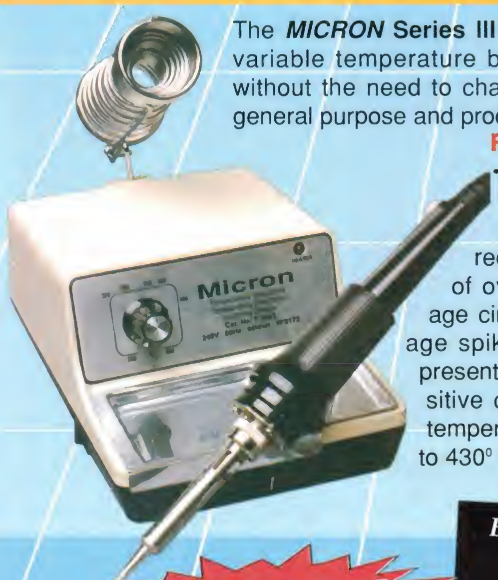

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Volume 57, No.3
March 1995

Hi-fi on wheels...

It may look like a standard Holden Senator on the outside, but inside there's an impressive hi-fi system based on the latest 'Ai-Net' components from Alpine Electronics. Louis Challis was able to borrow it for his subjective tests of the Alpine components — his review starts on page 8.

Oz-made engine analyser

In Auto Electronics this month, Nick de Vries reviews the new EM-606 handheld engine analyser, designed and made here in Australia by Emona Instruments. See page 89...

On the cover

Astronaut Susan J. Helms controls the Remote Manipulator Arm on NASA's shuttle Discovery, during the recent STS-64 mission to test the LITE and SAFER systems. (Picture courtesy NASA.) Our smaller photo shows the Emona Instruments EM-606 handheld Engine Analyser.

Video and Audio

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Projects and Technical

Professional Electronics

Columns and Comments

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ELECTRONICS AUSTRALIA is published by Federal Publishing Company a division of Eastern Suburbs Newspapers Partnership, which is owned by
General Newspapers Pty Ltd.
A.C.N. 000 117 322,
Double Bay Newspapers Pty Ltd.
A.C.N. 000 237 598 and
Brehmer Fairfax Pty Ltd.
A.C.N. 008 629 767,
180 Bourke Road, Alexandria, NSW 2015.

Printed by Macquarie Print, 51 - 59 Wheelers Lane, Dubbo NSW, 2830, phone (068) 843 444, for Federal Publishing Company.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Road, Alexandria, NSW 2015; Phone: (02) 353 9911.
ISSN 1036-0212
*Recommended and maximum Australian retail price.
The Australian Publication emblem on the front cover of this magazine is there to signify proudly that the editorial content in this publication is largely produced and edited in Australia, and that most of the advertisements herein are the products and services available within Australia.

LETTERS TO THE EDITOR

Internet e-mail?

I found Tom Moffat's column in the November issue very interesting regarding getting connected to the Internet. However, I was disappointed to find that the only e-mail address given was that of APANA, an organisation offering Internet connection services, and not that of the author himself.

Where your contributing authors are radio amateurs, their call signs are often given, so how about authors providing their e-mail addresses if they are able to be contacted by this means.

I know that not everybody is connected, but there seems to be an ever increasing number of organisations getting connected (here in New Zealand, at least) and it would be a great, high-tech way of finding and communicating with other people who have similar interests.

To get things started, my interests are in the areas of software development, microcontroller systems, sound systems and theatrical lighting. For my work, I teach in the area of Information Systems at a Polytechnic. My e-mail address is craig@manawatu.ac.nz. I would certainly be interested in communicating with others with similar interests.

Finally, is *Electronics Australia* on the Internet? It would be a great way of communicating with the magazine.

Craig Shearer,
Palmerston North, NZ.

Comment: We're not on the Internet, yet, Craig, but we should be soon.

Dry cell charging

Peter Phillips' article on the construction of a dry cell charger (*EA* January 1995), jolted my memory, so I went back through my collection and dug up some early material which throws interesting light on the business of reactivating dry cells. Here is some of it.

Of two letters in *Wireless World* of November 1951, the first notes that Amplivox Ltd, London, sold hundreds of six-volt trickle chargers during the War for reactivating dry cells for radio usage. The second notes that the process was used commercially in the USA during the War and that a description of recharging equipment was given in *QST* of June 1944.

In *Wireless World* for August 1953, Hallows discusses the battery conditions which are necessary if recharging is to be successful, and gives the experimental results on batches of dry cells. He also noted that Kobe and Graham of Washington University did their 'classic' work on reactivation in 1936 and showed experimentally that bell size dry cells could, by periodic reactivation, be made to deliver more than four-and-a-half times the amount of current theoretically available from their metal content (Papers of the Electro-chemical Society, 1938). He commented that before the War the Commonwealth Edison Electric Company of Chicago charged all its meter readers' flashlamp dry cells overnight every night, a practice in regular use.

And in *Wireless World* for October 1955, a reactivating charger for dry cells is described, which supplies 'dirty' DC or direct current with an amount of AC — i.e., direct current with periodic reversals which have less amplitude than the forward current.

So it's clear that experimental and commercial reactivation goes back at least 58 years.

David Paule,
Glenhuntly, Vic.

'Cooking' PCBs

Noel Smith of Springvale Victoria wrote on the subject of component removal from assorted printed circuit boards in your January 1995 issue.

I would not be the only one to recommend against this technique, on the grounds of component reliability and safety, for the following reasons:

- A frypan environment does not maintain thermal stability nor precisely indicate the temperature of the element, let alone the temperature at the surface of the oil.
- No consideration has been given as to cleaning processes, for removing any contaminants from the component leads prior to these components being reused.
- Special oils qualified for this purpose tend to render the frypan useless for future cooking purposes. Ordinary cooking oils such as peanut, olive or rape-seed may leave a film of contaminants on the component pins,

making future solderability difficult and such extended soldering attempts may again heat the device beyond its rated thermal tolerance.

- No preheating methods to avoid thermal shock of the components have been considered. This shock may result in hermeticity failure between the lead pins and the component body, allowing the ingress of moisture at a future date which will cause metallisation creep and thus accelerated failure of the component.
- No time period for immersion in the oil has been given. As the duration for the solder-melt process employing this procedure may very well result in excess heat, applied for a greater period than the manufacturer's ratings recommend for the devices recovered, then the component will have a more than even chance of arriving in the spares bin, 'dead on arrival'.
- All components will have to be simultaneously extracted, as they are all desoldered at the same time — a most difficult or impossible task.
- Some boards are soldered by a hot oil process, but this process is largely confined to high density surface-mount technology, under highly controlled conditions.

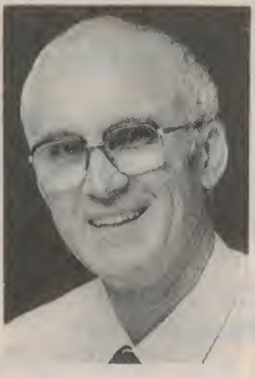
In conclusion, the diplomas of the host of Information Centre (B.Ed., Dip Ed., ECC) seem not to have been of assistance, as the only comment was 'it seems rather hard on the ICs, unless you can do the extractions reasonably quickly.' Between the time of publication of the reader's relatively uneducated ideas and the publication of this letter, how many hobbyists will have ruined many good devices, seeing that it had the implied 'try it' of a mostly-worthy journal, by being published in the first place.

'A trick is to wait until Mum goes out', is grossly irresponsible of you to qualify the lack of parental supervision in this article. Has anyone considered the possibility of persons receiving serious burns, because they regarded the article so published as to have the qualifications of editorial imprimateur? Inexperienced 'latch-key' teenagers read your publication, I'm sure.

Michael Chevallier,
Killara, NSW.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



The SMA's decision to increase amateur licence fees

Late last year, the Spectrum Management Authority signalled that it would be making a hefty increase to the licence fees paid by Australia's radio amateurs, in April. This is part of its overall program to overhaul all spectrum user licences, in line with its charter from the Government. Needless to say, though, many amateurs are quite upset at the prospect, and I've received a number of letters asking that *EA* should lend its support to the WIA's protest against the rise.

It's understandable that a lot of amateurs are upset by this decision, coming as it has only a couple of months after the SMA decision to change CB radio and handphone licences over to a no-fee 'Class Licence'. Radio amateurs have historically made a very worthwhile contribution to society, not only in terms of their role in the development of radio and electronics technology but also their provision of communications links in times of emergency. To see their own fees rising, so soon after those of 'Chat Band' users were abolished, is undoubtedly a bitter pill to swallow.

But is the proposed fee rise all *that* unreasonable? I dare say I'll be very unpopular for saying it, but frankly I don't think so. Amateur licence fees haven't risen for about 10 years, even though the cost of most other goods and services have risen quite significantly in that time. Some sort of rise was probably inevitable.

With all of the current and looming developments in communications technology, it's also inevitable that there will be increasingly fierce competition for space in the electromagnetic spectrum. In many ways this is a finite resource, and historically amateurs have accumulated quite a lot of spectrum 'real estate'. In fact I understand that in Australia, amateurs are second only to the Department of Defence in terms of their total allocations of spectrum space.

As part of its project to make licence fees more equitable for *all* users, the SMA has sought to base them clearly on the real costs of issuing and renewing licences, and also of managing each licensee's activities — together with a 'spectrum access cost' or tax, based on the perceived value of the spectrum segment(s) being used on an exclusive basis. On the whole this seems reasonable, and is in fact the kind of changes taking place in many other countries as well.

The problem for amateurs is that because quite a lot of spectrum is allocated to them, applying this rationale strictly 'across the board' would result in amateur licence fees rising to well over $500 per year. It's only after prolonged negotiations between the WIA and the SMA that the new fee structure has been whittled back to the levels now proposed (it now seems that even the unrestricted 'full call' fee will be less than $70, with further discounting if a number of years are paid in advance).

Now don't get me wrong. I'm sure that if the SMA could justify changing CB and handphone users over to class licensing, you could also work up an excellent argument for doing much the same for amateurs (as was done in the USA). But when you consider the total picture regarding Australia's radio communications, the projected rise in fees doesn't seem too bad — especially when you consider that the typical amateur probably uses transceivers and other equipment costing well over $2000.

It might well be prudent for amateurs to swallow hard and accept this fee rise, without much fuss. Attracting a lot of interest might cause renewed demands for some of that precious spectrum space, by potential users willing to pay a lot more for the privilege.

Jim Rowe

What's New in VIDEO and AUDIO

Cordless IR headphones

Beyer IRS890 and IRS790 Cordless Infrared Headphones are two new high performance systems that combine freedom of movement with the superior audio performance normally only associated with wired headphones.

The IRS890 provides the enjoyment of hi-fi or TV listening with the highest quality of sound reproduction and freedom of movement.

The system comprises three components — the IRH890 Cordless Headphone, featuring comfortable, soft ear cushions, automatic level control, individual left/right channel volume controls, switchable stereo, mono-left or mono-right, and powering via two 1.5V AA batteries; the very powerful IS890 Infrared Transmitter; and the LG890 Power Supply, for main powering of the transmitter.

Additional pairs of IRH890 Headphones may be operated simultaneously from the same transmitter, while additional area coverage in other rooms can be obtained with the addition of the ISS890 Slave Transmitter. The system boasts a frequency response of 18Hz to 24kHz with a maximum SPL of 110dB, and has a recommended retail price of $579.

The IRS790 offers similar features and provides 20Hz to 23kHz frequency response with 116dB SPL capability. It has a recommended retail price of $499.

New 'Digital Control Amplifier' from Sony

Top of the new Sony range of hifi components is the TAE2000ESD Digital Control Amplifier, claimed to be the most comprehensive high quality system available. Featuring advanced Dolby Pro-Logic the amplifier creates not only high quality stereo, but a three dimensional listening experience, close to if not better than the movies.

This model features Digital Reverberation/Delay Control. This allows the listener to control the indirect sound (the sound bouncing from the walls and ceiling), to create the most ideal setting or a favourite music venue. It also has Digital Dynamic Compression/Expansion, which enhances low level and inaudible sounds in digital recordings — as well as adding impact and depth to dull analog or mono recordings — while still maintaining sonic purity.

The TAE2000ESD also features a Digital Parametric Equaliser, allowing the user to digitally create the ideal acoustic environment. It has three separate bands, 16 slopes and

Home cinema sound from Bose

Bose Australia has launched a revolutionary home theatre system based on a new patented innovation, VideoStage, designed specifically to provide authentic cinematic sound in the home.

"Videostage is a real breakthrough in 'Home Theatre' technology. It is the first major advancement since Dolby Pro-Logic was introduced in 1988," said General Manager of Bose Australia, Bob Schenk. Videostage steering logic is a proprietary decoding circuit which, according to Mr Schenk, is the newest and best decoding algorithm available today.

Videostage logic replicates the movie experience by sending a portion of its 'surround' signal to the front left and right speakers. It is acoustically scaled to normal room size and is designed to enhance spatial realism and match sound all around.

This new technology is the key defining element of Bose's new Lifestyle 12 Home Theatre system, which comprises a stylish, slimline control box which houses the Videostage steering logic technology; five matched cube arrays, each with matched amplifier; and a single Acoustimass bass module with dedicated amplifier.

The control box also features a high sensitivity AM/FM tuner, quick access CD player and a radio frequency remote control with intuitive button layout that can operate through walls, ceilings and floors.

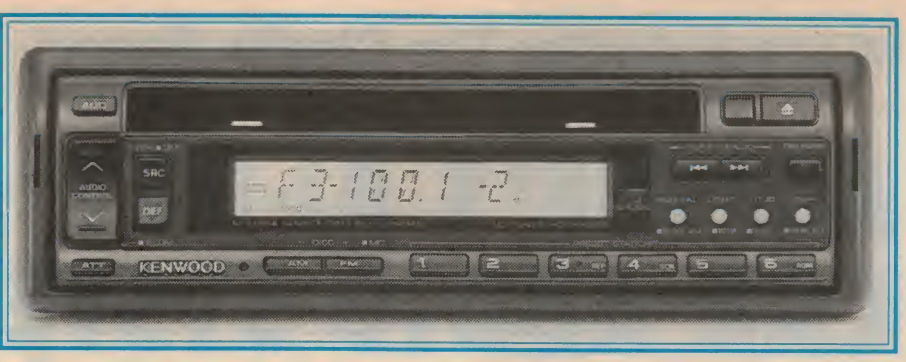
The new Lifestyle 12 Home Theatre system retails at approximately $4350.

90 different frequencies — in all more than 100 trillion different possibilities. During home theatre sessions, each channel can be equalised separately, allowing manual compensation for different quality speakers if more sound/noise is desired from a particular speaker.

Preset modules, called Digital Signal Processing Sound Fields, are programmed to create environments such as jazz clubs, stadiums, theatres or even the local disco. It can change the perceived room size, wall material and even the seat position (from front row to the last) in order to achieve the desired effect.

The Sony TAE2000ESD hs input and output functions for more than 15 different components, including three digital inputs such as CD players, DAT recorders and MiniDisc players. Sony's RRP is $2999.

Kenwood's new CD player/tuner for cars



Kenwood has announced its flagship CD player/tuner, the KDC-PS900, which incorporates an AM/FM stereo tuner, CD player and pre-amp in a single convenient dash mounted unit.

Designed to go with a high quality power amp/speaker system, the KDC-PS900 is claimed to represent the very edge of car audio technology. The circuit topology created many challenges for Kenwood's engineers, because unlike home component audio systems, particular attention has to be paid to layout and shielding due to the limited space and harsher environment.

Kenwood have addressed this by separating the DAC section, servo and signal processing circuits. Additionally, signal routes are kept to a minimum with special attention given to 'perfect grounding' concepts, to eliminate hum loops.

Another feature is the four-way selectable Liquid Crystal Display. Kenwood's research has has found that many drivers found standard LCD readouts difficult to read under certain light conditions. By changing the background to either amber or green and the readout from positive to negative reading station information becomes both a lot easier and a lot safer.

Kenwood's Full Theft Deterrent Faceplate or FTDF technology allows the faceplate to be removed, disabling the unit. The detachable faceplate then fits conveniently in the user's pocket or handbag and simply snaps back into place when the user is ready to listen.

A card size remote control with 10 key input addresses all the major features with separate bass, mid-bass and treble controls. Outputs are gold plated and an additional output is provided for use with a subwoofer.

The KDC-PS900 is covered by a twelve months parts and labour warranty, has an RRP of $1199 and is available at selected Kenwood car audio dealers.❖

'Slim Series' component hifi from Marantz

The Marantz Slim Series are elegantly styled and durable hifi components, available in two styles which strictly adhere to the company's philosophy of 'Pure High Fidelity'.

1020 Slim Series components are finished in a lustrous brushed aluminium, which blends readily with any modern decor. Behind the elegantly styled, motor driven front panels lie advanced electronics that deliver what is claimed to be true audiophile quality sound reproduction. The attention to detail and no-compromise approach to sound reproduction employed in the Slim Series components is the same used in the highly acclaimed and award winning range of Marantz audiophile components.

The 1010 Slim Series offer an affordable alternative, featuring similar performance but without the motorised front panels and finished in non-reflective matt black.

Comprising a receiver, compact disk player and cassette deck, the Slim Series opens up new horizons for system building. In addition to these components, Marantz will soon add Dolby Surround, DCC, and a number of new and innovative components to extend the range further.

The SR1020/SR1010 Receiver combines a discrete component, high power output amplifier with an FM/AM tuner section. It delivers 2 x 45W per channel (DIN power output at eight ohms) with capacity for six audio source inputs, a motorised volume control, automatic and manual tuning with 30 station memory, and full remote control capability with the supplied 32-key infrared remote commander.

The CD1020/CD1010 Compact Disc Player features a newly developed single-bit digital to analog converter and an 18-bit, eight times oversampling digital filter for superb tone and image accuracy. Integrated stabilised power supplies ensure the signal output is free from digital 'harshness' common to single designs. Both players offer edit recording, peak level search and automatic music scan functions and are fitted with an optical digital output.

The SD1020/SD1010 Cassette Deck employs a full logic controlled auto reverse cassette mechanism with an integral cassette shell stabiliser for optimum tape stability. Super hard metal alloy tape heads deliver stable, extended sound. Other features include a real time tape counter, automatic tape type selection, and synchronised recording capability with the compact disc player.

ALPINE'S Ai-NET CAR AUDIO SYSTEM

This month, our reviewer Louis Challis had the opportunity to both test and audition key components in the new Alpine Electronics range of hi-tech car entertainment systems. The new units offer an almost mind boggling range of functions and facilities, he found — together with a particularly high level of performance, evident both in the lab tests and during a trip in a loaned Holden Senator fitted with a complete system...

It's unusual for a Japanese manufacturer to release a product in Australia prior to releasing it in the USA. But I guess it had to happen sooner or later, even though the US market is potentially more important. Of course, the US car audio market is not only the largest, but the Japanese manufacturers also consider it the most important. It has attracted literally thousands of manufacturers, all of whom vie for an increasing slice of that market. More pointedly, they recognise its special characteristics, and that in turn has directed their R&D efforts — and specifically, their approach to their 'premium' products.

But what's so special about the American car audio market? Firstly, the market has displayed an obvious clear preference for 'superior technology'. Nowhere is this more obvious than at the Winter CES in Las Vegas. There you'll find hundreds of different manufacturers side by side, each extolling the virtues of this or that 'Superior Product'.

Now don't get me wrong! Most of those products *are* superior when compared to the previous year's product. Notwithstanding, the giddying pace of constant changes and improvements is worrying. Even the manufacturers have expressed concern as to where all this will end!

The Alpine Ai-NET Car Audio system is an excellent example of how, where and why a prestigious Japanese manufacture of car audio has directed its R&D efforts to produce a truly superior product. Now Alpine — unlike Sony, Technics, Pioneer, Philips, Mitsubishi and many other big players in the consumer electronics field — just specialises in car audio (and directly related products). They don't make vacuum cleaners or video recorders; but as I discovered, they *do* make special miniature TV monitors for cars.

A view inside the Holden Senator, kindly loaned by Graham Humphries of 'Power Sound and Security', with its impressive installation of an Alpine AI-Net system.

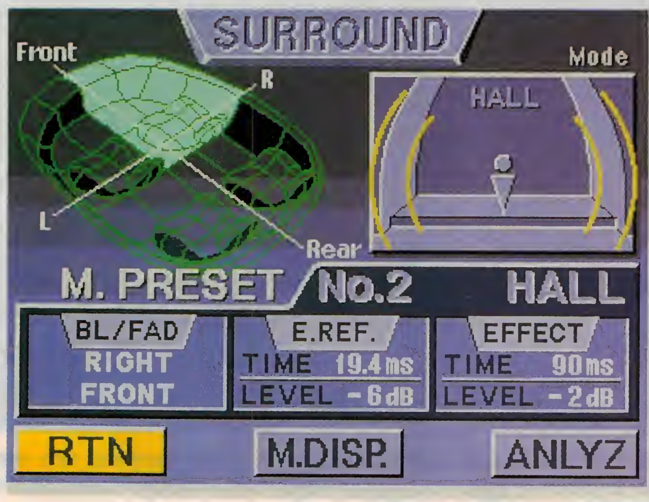
When the Alpine R&D and marketing people examined the US market to analyse what approach they should take in developing their latest 'superior product', they decided that the following deficiencies, or common problems should be addressed:

1. The system should be able to provide an 'in-car' sound quality comparable to that provided by the car owner's home hi-fi system.
2. The head unit — which in this case is the AM/FM/cassette radio module, should provide centralised control of all functions. More importantly, it should simply interface with all external peripherals using a new, innovative and high speed bus control system.
3. As an extension of (2), the method chosen for extension should use a single cable harness through which all signals (two channels of audio, peripheral data, controls and battery supplies) should be carried free of any RFI interference.
4. The system should be capable of tailoring the sound field characteristics to match the specific desires and dictates of the vehicle's driver, or its passengers.
5. To place the system fairly and squarely ahead of the competitors, it should offer optional visual advantages. They decided that this visual display would take the form of a colour LCD monitor screen, replete with digital display processor. This would then prepare the Alpine car audio system for future automated map positioning displays. (As I understand it, Alpine have a line of other innovative new products in the pipeline, which would also use this display potential).

Well as I've now discovered, Alpine has implemented this plan, and the results are both technically and aurally superior to their previous products.

Basic system

The basic system employs either a TDA 7638 or a TDA 7537E head unit, with a CHA S607 Six Disc CD Shuttle. My evalua-



Top left: The TDA-7537E head unit, which combines the functions of an AM/FM tuner and cassette player, and provides an unusually large number of features.

Top right: The CHA-S607 six disc CD shuttle. The Ai-Net system can incorporate up to six of these shuttles, for those with a very healthy bank account.

Left: An example of the screen displays available on the TVA-MO13P4 In-Dash LCD Monitor and Video Recorder, which was also fitted to the Holden Senator made available to Louis for his road test.

tion has been restricted primarily to those units. Later on I'll digress from that plan to recount how I was nearly seduced by their Alpine Visual Interactive Controls.

The head unit with which I was provided was a TDA 7537E. Alpine have incorporated an unusually large number of features, facilities and functional controls into this single DIN height module AM/FM/cassette player. In point of fact, they have incorporated so many features that on my first reading of the owner's manual, I thought that I might not be able to master all of those controls in the limited time available.

The first and most obvious feature of the head unit is the detachable front panel. This comes complete with a neat carrying case. Yes, removable panels *do* deter thieves, but nobody knows by what degree...

With the detachable front panel in place, and the unit powered up, you observe that the controls and display functions have been subdivided into six major areas. As I soon discovered, with some minor exceptions, a large proportion of these controls have multiple functions. The precise function depending on which specific operating mode has been selected. Rather than fully describing the control panel layout button by button, which would otherwise be too time consuming, I've opted to describe what functions are actually provided.

Obviously with 28 individual buttons or controls on the removable front panel, the majority of which can activate or control more than one function, the power and potential to provide special functions 'borders on the sublime'. Thus by way of example, with two 'simple' volume increase/decrease buttons and a centrally positioned MODE switch, the unit is able to separately activate and control VOLUME, TREBLE, BASS, BALANCE and the FADER...

The two outer volume control buttons are also provided with dual speed operating modes. If you press the buttons harder, then the rate of functional change is also faster. More importantly, once set, each of those specific settings (for each of the functions) is memorised until such time as they are manually changed again. The centre button also provides control of the loudness contour, which some users may appreciate.

At the lower left corner of the front panel are three illuminated control buttons. The first provides control over the AM/FM/VCR tuner (yes, it has provision for a VCR). Pressing this button repeatedly changes the band selected, firstly from the AM band, and then to the two FM bands (both covering the 88 - 108MHz band, but each providing for six stations).

Another key component in the new Alpine Ai-Net range is the PRA-H400 Digital Time/Frequency Processor, shown here.

A view inside the boot of the Holden Senator, showing the compact but very effective bass speaker enclosure installed under the parcel shelf by Power Sound and Security of Parramatta.

In conjunction with other controls at the top right hand corner of the control panel, a wider range of controls are provided. These include manual selection of station frequency, seeking a local station (of low sensitivity) or seeking a remote station in the DX mode. The receiver will automatically seek stations if either of the UP or DOWN buttons are selected for more than 0.5 seconds.

In conjunction with the group of six multi-function buttons in the lower central front panel, the desired station preset frequencies may be stored or alternatively accessed. A further logging option is provided in the form of a DIRECT ACCESS PRESET (DAP) band. This facilitates storing any six AM/FM stations onto the DAP memories.

If you are interested to know what the electrical field strength of a preset station frequency may be, this too can be determined. By selecting the nominated station frequency, and by then pressing the 'T RECALL' for five seconds while a cassette or CD is being played, then the LCD display will show an 'L' number in addition to the other data that is being displayed for the cassette or CD.

These 'L' values range from L- to L8, with L- corresponding to the minimum signal level and L8 to maximum level or the best possible radio reception conditions. As I subsequently discovered, the AM and FM tuner sensitivities of the head unit are particularly good, and I only once observed the L- sensitivity. The AM/FM tuner sections in this particular head unit are on par with the best car radios I have yet tested.

The second button of the three at the lower left corner controls the cassette player's PAUSE/PLAY modes. All one has to do is insert a cassette into the central cassette well and the tape will start playing almost immediately.

Manual selection of Dolby OFF, Dolby B or Dolby C is also provided. You may even select a mode for TAPE REPEAT. The tape will the play repetitively until reset. Another operating mode offers automatic skip over sections of the tape with blank sections exceeding 15 seconds.

Auto head cleaning

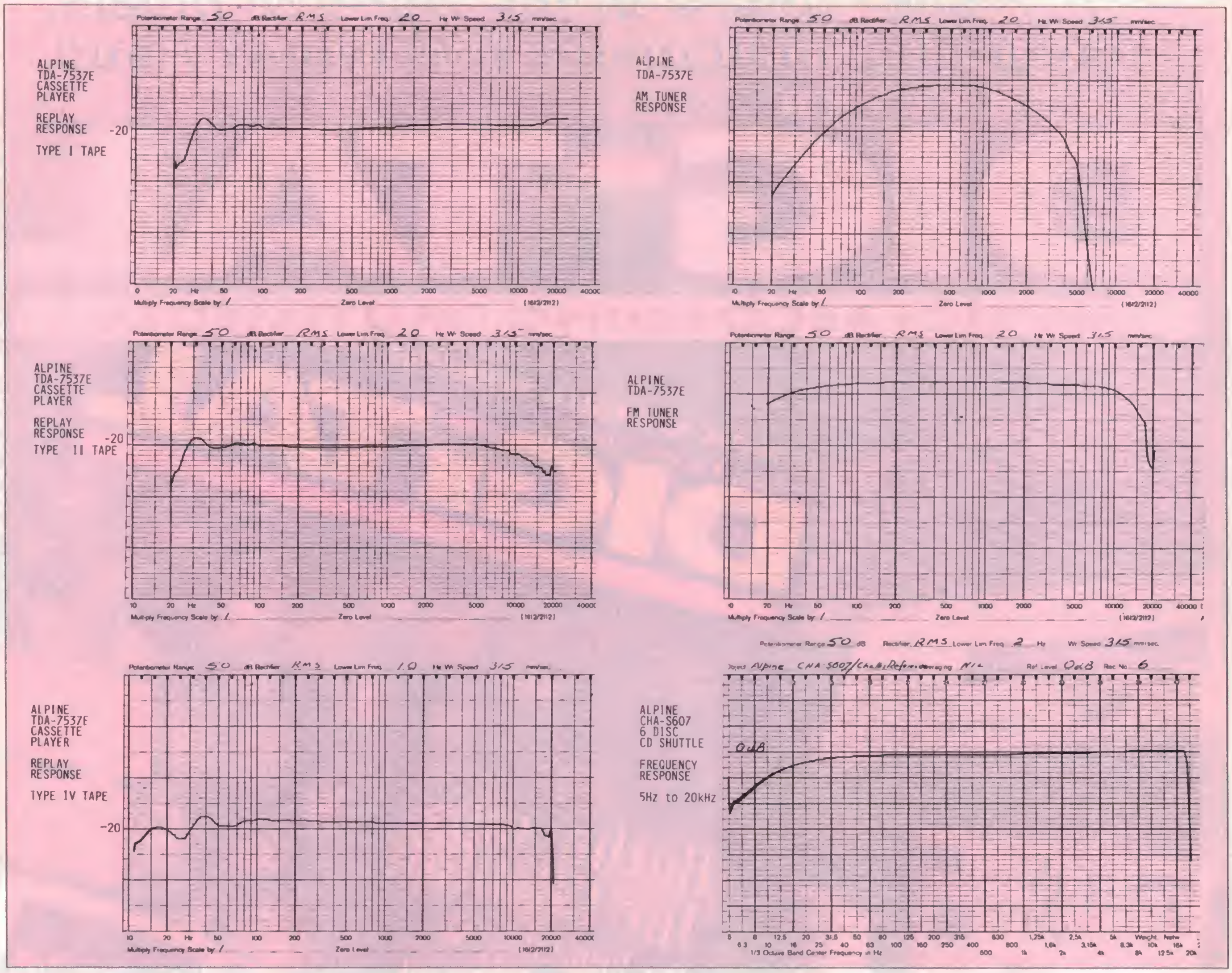
All the new Ai-NET head units now incorporate automatic tape head cleaning systems. Destructive and aurally disturbing unwanted dust, or more insidious magnetic debris which invariably collects on the replay head is cleaned away each time a cassette is inserted, or removed from the cassette player.

Other controls provided for the cassette player include MANUAL REVERSE, and the ability to monitor the radio whilst fast forwarding or rewinding a tape. More innovatively, the unit incorporates a pair of 'PS' or Program Sensor switches, one for UPWARD and one for DOWNWARD selection. Depending on the number of times one or the other of those switches is depressed, these determine the number of selections the cassette tape will advance or rewind before playing the nominated track.

The third of the three illuminated switches at the lower left hand corner controls the CD shuttle. If the button is pressed, the CD Shuttle is automatically activated. In the absence of any other instruction, it will start playing the first CD in the magazine, or the disc in the subsequent loading slot. Alternatively, by pressing one of the six buttons on the front panel, the CD in the location corresponding to that number (in the CD magazine) will be played. Any required track on the CD may be accessed through the use of the two buttons which were previously used for station searching. These are now transformed into FAST FORWARD or MUSIC SENSOR - SKIP buttons.

The REPEAT PLAY button that we previously used for repeat playing a cassette now fulfils the same function in the CD mode. In keeping with domestic CD players, a RANDOM (MIX) PLAY function has also been provided.

This view through the Senator's rear window shows the speaker grilles fitted into the parcel shelf.



The measured performance curves for the Alpine TDA-7537E and CHA-S607. On the left are the tape replay response curves, with type I tape at top, type II tape in the centre and type IV tape at the bottom. At upper right is the AM tuner response, with the FM tuner response at centre right and the CD player replay response at lower right.

Another button is labelled SCAN. When it is activated, the CD shuttle plays the first 10 seconds of each track in the CD magazine. You may thereby identify the contents of your six discs (or that selected) in very rapid time. This is particularly helpful if you intend to title your discs and their contents.

Although the labelling process is laborious, the CD shuttle programmable TOC (table of contents) memory can be accessed through the head unit. Unfortunately, it would appear that Philips and Sony goofed when designing the original CD format. This is one function that really should have been accommodated by each disc's TOC.

This issue has been subsequently addressed by both Philips' DCC and Sony's Mini Discs. I suspect that it's NOT TOO LATE for CDs, but I doubt that my plea will be noted by either Philips or Sony.

Multiple shuttles

Where an owner is particularly affluent, the Ai-NET system facilitates the interconnection of two or more CD shuttles (up to a maximum of six). The Ai-NET thereby provides the capability for up to 36 hours of pre-recorded music. Whilst that option may be available, it's doubtful that it will be all that popular — except perhaps in tourist buses and boats. A multi-changer switching device (KCA-400C) is then a mandatory supplement to the system.

Access to the alternative CD Shuttle can be effected through the head unit, or even more conveniently by means of the optional wireless remote control unit. If passengers wish to control the head unit from the back seat, then the remote control unit is clearly a must.

Alpine provided me with an eleven-band equaliser/sound field controller. This unit and its alternative digital divider unit also may be operated and controlled from the front panel by the Audio Processor (A.PROC) switch. When a sound field controller is fitted, you can tailor the frequency response of the whole system to compensate for unwanted resonances, or to tailor the characteristics of the fitted loudspeaker system. As I subsequently discovered, the ability to tailor the car audio system's overall response is a desirable plus. As if all of these functions are not enough, the head unit also displays the time. The colour of the illuminated display may be altered to suit an owner's personal tastes.

Objective testing

With so many parameters and functions incorporated, I simply had to cut down the number of objective parameters that I would be evaluating. That decision, as to what I should or should not

evaluate, was not so complex as I already knew what I wanted to examine more closely. When faced by such a dilemma, I consider the most important parameters to be the *frequency responses*, the *distortion* performance and last but not least the *RF sensitivity*.

The frequency responses of the main elements have each been graphed and are presented below. As you can see, the FM frequency response is good but not superb, being -3dB down at 28Hz and 12kHz. This is however more than adequate, as in the end the installed loudspeaker response will really determine what you will hear.

By contrast, the AM band frequency response is only a miserly 2kHz wide. The upper and lower -6dB points are 70Hz and 2.5kHz. That is unfortunately the current trend, where selectivity between competing channels predominates over audible quality of the signal presented. What surprised me was the unusually good replay frequency response of the cassette player on Type I and II tapes, as well as Type IV metal tapes. Even on Type I tapes at -20VU the replay response is excellent, being -3dB down at 25Hz and 20kHz. On Type II tape the measured replay response is good with -3dB points of 25Hz and 14kHz. On type IV tape the response is marginally better.

Obviously the replay response of the cassette player can be no better than the quality of the cassettes you purchase or prepare yourself. Notwithstanding, with AUTO selection of replay equalisation the Alpine cassette player offers truly scintillating performance.

Before I could test the CD Shuttle, I had to connect it into the system. I initially had a few anxious moments as things started to come unstuck. I discovered that there are two Ai-NET sockets on the rear of the head unit, and initially I had plugged the Ai-NET plug into the wrong socket. Needless to say, nothing happened. At first I thought that there must be a separate battery power supply connection. I gave this further thought, and looked at the unit, as that was contrary to the theory. I re-plugged the lead into the second socket, and PRESTO, the system came to life.

I was not the least bit disappointed with what I then found. The CD player achieves an excellent 12Hz to 20kHz bandwidth, with adequate linearity in the nominal operating frequency range.

To be on the safe side, I evaluated the CD player's digital to analog conversion linearity, as well as its harmonic distortion characteristics. Whilst the CD's Shuttle's performance is not quite in the same league as the most expensive home CD players, its performance was impressive nonetheless.

MEASURED PERFORMANCE OF ALPINE TDA-7537E SERIAL NO. M409 101 06A

CD FREQUENCY RESPONSE CHA-S607 SERIAL NO. H4 10 135 41

1. Frequency response 20Hz to 20kHz +1 -1.5dB
5Hz to 22.05kHz +1 -10dB

2. Linearity @ 1kHz

Nominated Level	Left Channel Output
0dB	0.0
-1.0	-0.9
-3.0	-3.0
-6.0	-5.9
-10.0	-9.9
-20.0	-20.1
-30.0	-30.2
-40.0	-40.2
-50.0	_50.2
-60.0	-60.2
-70.0	-69.8
-80.59	-79.4
-85.24	-86.8
-91.4	-88.14

3. Distortion @ 1kHz for total Ai-NET System Input to Output

Level	2nd	3rd	4th	5th	THD%
0	79.3	84.6	83.1	77.5	0.036
-3.0	76.8	78.9	88.1	81.7	0.038
-6.0	78.2	79.0	90.1	85.6	0.03
-20	88.3	79.1	91.6	78.6	0.027
-40	64.7	61.4	60.6	-	0.24
-60	59.6	51.0	53.7	45.2	1.1
-70	48.2	37.2	-	-	1.8
-80.59	-38.7	33.8	36.9	37.3	6.0
89.46	30 .6	-	23.3	16.9	24.0

Distortion @ 100Hz

Level	2nd	3rd	4th	5th	THD%
0	69.2	91.0	96.3	83.6	0.042
-20	85.6	81.1	94.1	80.1	0.026
-40	64.3	61.6	62.0	80.4	0.23
-60	62.0	49.7	51.7	45.6	1.2

Listening tests

Having satisfied myself that the objective performance of each of the components really was as good as stated in the manufacturer's data sheets, I played some pre-recorded cassettes and CDs in the laboratory, as the first stage of my auditory assessment. For the cassette evaluation I selected 'Brahms Symphony No 2', with Bruno Walter conducting the Columbia Symphony Orchestra (Sony CBS 40-44870). The audible fidelity was excellent, and I could both detect and measure frequency components extending beyond 15kHz on my real-time analyser.

An equally important test is how well the CD player performs on CD software. For that evaluation, I used two discs. The first was Dave Brubeck's first solo recording in almost 40 years, entitled 'Just You, Just Me' (Telarc Jazz CD-83363). This is an outstanding disc and a real must if you are, or you were ever a Brubeck fan. Track 4 with its variations on 'Brother, Can You Spare a Dime?' is outstanding.

I progressed to Alpine Electronics' own sponsored disc 'Highway One' (Devine Music DEV 002). This disc also provided an excellent *pot pouri* of pop, rock and singing, with which I evaluated the system's audible performance. I retained all of my initial admiration for the system, but by then I realised that without a road test I would never really know what — or more pointedly, *how* the system would perform 'in the real world'.

My first thought was to install the system provided in my own SAAB, which already has a factory installed Alpine AM/FM cassette player. That would have provided a direct comparison, which is what I really would have liked.

However time was against me, yet again. As a practical compromise, I was offered an admirable alternative. As it happens, Graham Humphries of 'Power Sound and Security' of Parramatta, had recently installed a TDA-7537E head unit with CD Shuttle, supplemented by a TVA-MO13P4 'In-Dash LCD Monitor and Video Recorder' in his new car. All up, he has about $15,000 worth of well chosen audio, speaker and associated hardware carefully installed in his new Holden Senator sedan.

This car was offered to me for my evaluation for two days, with no questions asked as to where I would go or what I would look for. Although I found the video display unit tempting, and briefly examined its beguiling and seductive advantages, I elected to leave the review of that part of the system to some future time.

So I grabbed a small bag of clothes and kit, my wife did the same and we drove up to 'Glen Ellen' Guest House at Blackheath.

With a two hour drive up into the Blue Mountains, and a wide range of RF propagation conditions en-route, I had an appropriate means of evaluating the Alpine car radio's RF system performance.

Continued on page 93

Radio astronomy and the discovery of pulsars:

PUTTING A 'SPIN' ON RADIO STARS

Possibly the most exciting discoveries by radio astronomers, over the last 30 years, have been those concerning pulsars — which produce rapidly pulsating radio signals. Major contributions to the knowledge of pulsars have been made by Australian astronomers, and an important study involving the Parkes Radio Telescope was completed last year.

by GEOFF McNAMARA

It's an interesting problem, when you think about it. If you had discovered regular pulses of radio waves being transmitted from deep space, radio signals that looked anything but natural, how would you tell the world?

After all, respectable scientists aren't in the habit of announcing the discovery of alien civilisations (unless, of course, they're deliberately looking for them!). But that's just the dilemma that faced Jocelyn Bell in 1967. As it turned out, Bell had discovered something just as unexpected: a new astronomical phenomenon that would confirm a 30-year-old theory and revolutionize what we understand about stars.

As a young PhD student, Bell was looking for *quasars* — incredibly distant and powerful radio sources. Just as stars twinkle in the night sky, quasars 'twinkle', or scintillate, when seen by radio telescopes. But unlike stars, which twinkle because of the Earth's atmosphere, quasars twinkle as their radio waves pass through the interplanetary medium.

The space surrounding our solar system is filled with the *solar wind*, a stream of charged particles radiating outwards from the Sun. Because the solar wind isn't uniform, the radio 'image' of a quasar is diffracted as it travels to Earth.

Further, just as only point-sources like stars twinkle in the night sky, so only distant, point-like radio sources such as quasars twinkle in the radio spectrum. So, looking for radio sources that scintillate is a good way to search for quasars.

The observing programme was being run by Antony Hewish, using a radio telescope specifically designed and built for the job. A total of 2048 dipole antennas were erected over a four-acre field at the Mullard Radio Astronomy Observatory, near Cambridge in England. Observations began in July 1967. The telescope observed at a frequency of 81.5 megahertz with an integration time (the radio equivalent of photographic exposure time) of about 0.1 second.

The telescope was itself stationary, and observed the sky from west to east simply by letting the sky pass overhead as the Earth rotated. The telescope could be made to 'point' further north or south by introducing phase delays into the signals from the east- west rows of dipoles. It was Bell's job to wade through kilometres of paper chart recordings, looking for and identifying scintillating radio sources, and making sure they weren't man-made interference.

One night she noticed some 'scruff' in the data that didn't look like *either* a scintillating source or man-made source. Bell and Hewish decided it deserved closer examination. But just as she was about to make high-speed recordings of the object by passing the chart paper faster under the pens, the object disappeared.

This wasn't surprising, since weak signals can get lost in the noise. But in late November the source returned, and Bell watched impatiently as the pen traced out a series of regular radio pulses. By measuring the distance between the pulses she found that they were a regular 1.3 seconds apart.

Regular radio pulses suggested that the source was man-made — but the records of the past several weeks showed that it moved with the stars. In other words, the source was celestial, not terrestrial. Could it have been celestial and artificial? If so, how do you tell the world? Bell became annoyed at the whole situation: there she was trying to earn a PhD, and some group of 'little green men' had chosen her frequency and that particular time to transmit to the Earth.

Another one!

In fact Bell had discovered the first pulsating radio source — soon abbreviated to *pulsar* — in July 1967. Six months later she found a second one, in a different part of the sky. Here was a mixed blessing: the chances of two groups of aliens transmitting to the Earth at the same frequency from two different parts of the sky were remote. But if the pulsars weren't alien transmissions, what *were* they?

Astronomers knew that stars were rhythmic: all rotate, some of them even pulsate. But the time scales were measured in weeks or years, not seconds! A star rotating or pulsating once a second would simply blow itself apart! What could be causing such regular and frequent radio pulses? The answer lay in a theory proposed over 30 years earlier.

In 1932, James Chadwick announced his discovery of the neutron, a small, chargeless particle found in the nuclei of atoms. It's said that within hours of hearing of the discovery, the great Russian physicist Lev Landau conceived of a star made of nothing but neutrons. Such a 'neutron star' would be very small, and very dense. But it was left to two astronomers, Walter Baade and Fritz Zwicky, to describe how an ordinary star could turn into a neutron star. With some adjustments, the story they told remains basically the same:

The massive star wandered aimlessly through the galaxy as it had for millions of years, a mere blink in the nine thousand million year lifetime of a small star like the Sun. But to the massive star it was all the time it had. Its bulk caused its nuclear fuel to 'burn'

faster than in smaller stars, making it shine brighter in the night sky. But it also meant that its lifetime was correspondingly shorter, and its death was going to bespectacular.

Like all stars, the massive star had condensed out of a large cloud of hydrogen along with dozens of others. The cloud broke up into fragments of various sizes, including one very large fragment. The fragments became 'protostars' — slowly contracting spheres of hydrogen that glowed dimly in space. Like the others, the massive protostar contracted; the temperature in the centre rose. At last the temperature reached some 10 million degrees, hot enough for the hydrogen atoms to fuse into helium, giving off tremendous amounts of energy in the process. The star was born. The radiation pressure from the nuclear reactions going on inside the star nicely balanced the crushing weight of the star itself. But its tremendous bulk caused the hydrogen fuel to burn at a fantastic rate, and a mere 20 million years later it faced a crisis as its store of hydrogen fuel began to run out.

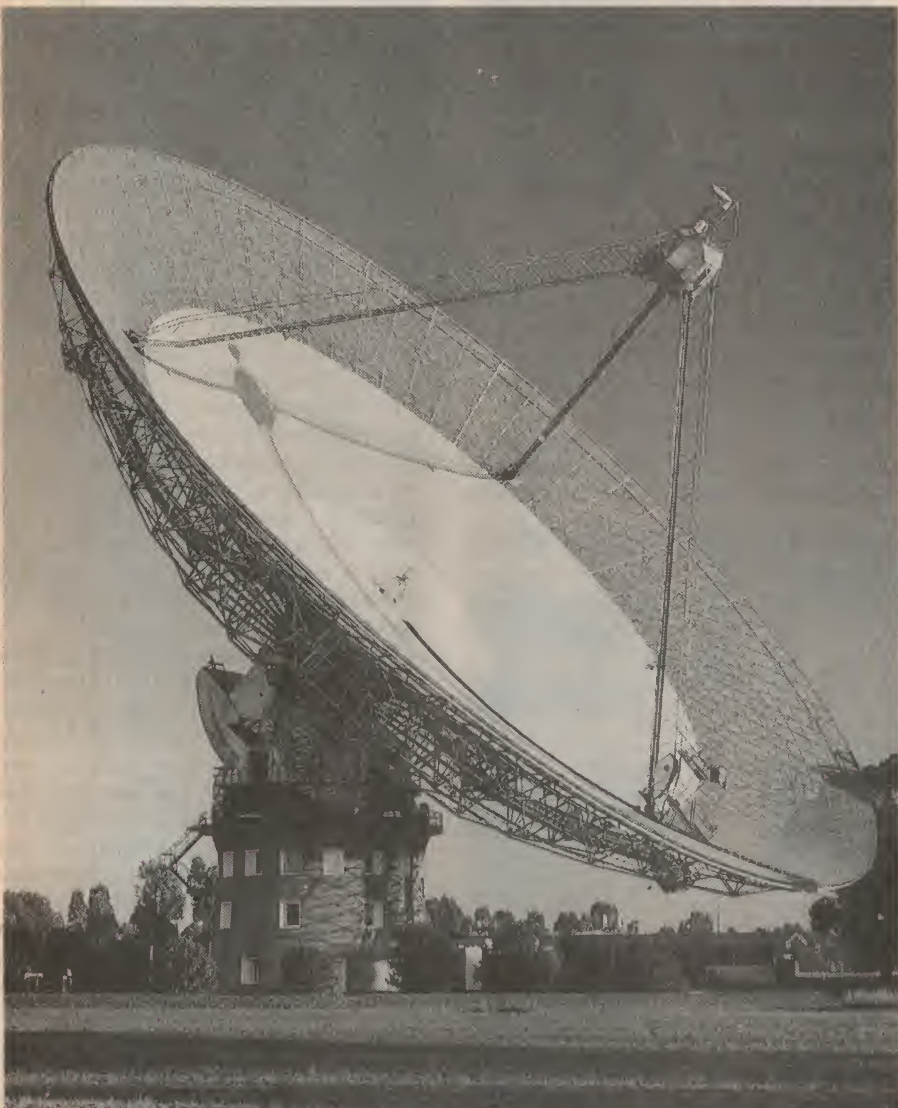
The star now had a helium core surrounded by a shell of hydrogen. But with no nuclear reactions going on inside the helium core, it began to collapse. The outer layers of the star, no longer bound by the bulk of the collapsing star, expanded and cooled. The star had become a red giant. But as the helium core collapsed, it became denser and hotter. eventually it reached 50 million Kelvin, hot enough to trigger the fusion of helium into carbon, restoring the star's source of radiant energy. It had been given a reprieve.

With time the core turned to carbon and the star once again faced a turning point. The cycle repeated and the carbon was converted to neon, and within a thousand years the neon began to burn to silicon. Within a year the star's core consisted of silicon. The collapsing core rose to a temperature of 400 million degrees, and began to burn the silicon to iron. The process was complete within a few days.

Here at last was the final breath the star would take in its present incarnation. All of the previous reactions converted lighter elements into heavier elements, producing energy that kept the star shining. But Iron cannot be converted into a heavier element without using energy. With nothing left to burn, star's core collapsed catastrophically. The inward falling matter bounced off the collapsing core and was blown outwards in a titanic explosion. For a brief cosmological moment the dying star shone brighter than the entire Milky Way galaxy of 100 thousand million suns. The supernova was seen across intergalactic space.

The outer layers of the star continued expanding into the interstellar medium. But glowing faintly in the centre, a strange object was slowly revealed. The star's core had been crushed under its own weight, reduced from the size of the Sun to the size of Sydney. The weight of an entire sun had been squeezed into a sphere only 20km across. The tremendous pressure had fused the protons and electrons together to form neutrons. A teaspoon-full of this 'neutron star' weighed 10 million tonnes...

The theory received less than total support, and besides, how could you ever see such a small, faint object? Stars shine in the night sky for two reasons: one, they're hot, and two, they're big! For this reason, the neutron star remained mere theory and was largely ignored by observational astronomers.



This 64m radio telescope at Parkes in NSW, which has played a leading role in the search for millisecond-period pulsars.

Other ideas

Thomas Gold was teaching at Cornell University in the United States at the time pulsars were announced. While other astronomers puzzled over how to make a star pulsate or oscillate, Gold had his own ideas. Early attempts to link pulsars with neutron stars involved making the neutron stars oscillate. But when theorists looked at vibrating neutron stars, they found they oscillated too fast. So Gold looked at how fast a neutron star could rotate.

After all, rotating objects are among the most regular phenomena in the universe. Every star rotates, and massive stars are no different. Gold reasoned that

as the dying core of a massive star collapsed during its supernova phase, it spins faster — the same way an ice-skater is able to spin faster simply by bringing their arms in closer to their body. By the time it had become a neutron star the size of a city, it was conceivable that the neutron star would be rotating every second.

This explained the period of the pulses — but what was causing the pulses themselves? As the core collapsed, so did the star's magnetic field. Electrons accelerating through the now highly compressed magnetic field emit radio waves along beams coming from the magnetic poles of the neutron star. If the magnetic axis is off-set from the rotation axis of the neutron star, then the beams emitted from each magnetic pole sweep through space like the beam from a lighthouse. If the Earth is in the path of one of these beams, the radio emissions can be seen as a series of pulses...

Since the initial discovery and explanation of pulsars, various searches have been made for more of them. After all, even if you don't understand an astronomical phenomenon you can still look for more examples, watch what they do, and so on.

One of the first pulsar surveys was conducted using the Molonglo Radio Observatory in Australia. The 1971 survey covered the entire southern sky with a sensitivity of 80mJy. By looking at chart paper recordings, 31 new pulsars were discovered.

A 1972 survey conducted from Jodrell Bank in England searched the plane of our galaxy, using computers to search for periodic signals, resulting in 39 new pulsars. A further 40 were discovered using the giant 1000-foot Aricebo radio telescope in Puerto Rico, in 1975.

Australian success

The most successful pulsar survey, however, was carried out in 1977 by astronomers from the CSIRO's Division of Radiophysics and from the University of Sydney. Under the leadership of Dr Dick Manchester from the CSIRO, the astronomers used the 64-metre radio telescope at Parkes in western NSW to survey the entire southern sky. The Molonglo Radio Telescope was used to search for pulsar 'suspects', while the Parkes Telescope was turned to each one in turn to confirm the nature of the source.

Over two and a half thousand suspects were detected using the Molonglo Telescope, but many of them turned out to be multiple detections of 'bright' pulsars, or simply interference. 320 candidates were eventually observed from Parkes, resulting in 155 new pulsars. The Parkes survey more than doubled the number of known pulsars!

By the early 1980's, astronomers were still in a spin over Bell's 1968 discovery. On the other side of the world from the Mullard Radio Astronomy Observatory, however, another graduate student was about to revolutionize pulsar astronomy with a discovery of his own.

In 1962 a radio source had been discovered in the constellation of Vulpecula. Later, more detailed maps of the area showed a small, condensed radio source with a larger object nearby. This and other clues convinced a team of radio astronomers lead by Don Backer from the University of California, Berkeley that a pulsar was there somewhere.

In October 1982, Kulkarni was using the Arecibo telescope to search the area and discovered the suspected pulsar. But this was no ordinary pulsar. While astronomers were still gazing with wonder at pulsars with periods as short as 33.1 milliseconds, the pulsar discovered by Backer's team had a period of only 1.56 milliseconds. The star was rotating 642 times every second! The first, and to this day fastest, 'millisecond pulsar' had been discovered.

Dr Dick Manchester working at the control console of the Parks radio telescope.

Question: how?

The discovery of a star that was rotating at 90% of the speed needed to break it apart was indeed a bizarre twist. But the biggest question now facing astronomers was how to get a pulsar up to that speed in the first place. Could the collapsing core of a massive star reach such a fantastic rotation rate?

There was a major stumbling block with this idea. Astronomers had learned to estimate the age of a pulsar by looking at how its period changed with time. When a pulsar is young, its magnetic field is very strong, and this causes the pulsar to slow down. As the pulsar ages, its magnetic field weakens, and so the pulsar 'spins down' at a slower rate.

But when astronomers looked at the way millisecond pulsars were slowing down, they found that the period was increasing very slowly. Here was a paradox: the short period indicated youth, but the slow spin-down rate indicated a weak magnetic field, implying tremendous age. How could an old pulsar be spinning like a youngster?

There are a number of theories on how to make a millisecond pulsar, but all involve 'recycling' an ordinary pulsar that's reached the end of its life. Imagine a pair of stars in a binary system. If one of the stars is large, it will age faster than its companion, becoming a red giant and eventually exploding as a supernova. The resulting pulsar will then share a common orbit with the normal star.

Now the lower mass star will eventually age as well, itself expanding into a red giant phase. But the lifetime of low mass stars is measured in billions of years, not millions. By the time the low mass star becomes a red giant the pulsar will have spun- down to the stage that it no longer emits radio beams and has stopped 'pulsing'. In a sense, the pulsar has died.

Imagine the dead pulsar near the ex-

panded red giant star. The gravitational attraction of the massive neutron star pulls the outer layers from the bloated red giant star. The mass spills over onto the neutron star, making it spin faster as it gains weight. Faster and faster spins the neutron star, once again emitting radio beams. The pulsar sucks yet more mass from the red giant star, gaining speed. It spins-up past its original rate, all the way up to millisecond pulsar speeds.

Observations of millisecond pulsars in binary systems seems to confirm the general idea. In at least one binary system, the millisecond pulsar has destroyed what remains of the ordinary star, earning it the title 'Black Widow Pulsar'.

Further search

Once again, the search was on, and again the most successful search has been carried out from Australia using the Parkes telescope. Dick Manchester led a team of astronomers from Australia Telescope National Facility, Jodrell Bank, and the Instituto di Radioastronomia CNR, in Italy. The survey began in mid-1991, when only eight millisecond pulsars were known in the Milky Way galaxy.

The survey involved pointing the Parkes Radio Telescope at a total of 45,000 points on the sky. Observing at a frequency of 436MHz, each observation lasted about two and a half minutes. The data were sampled at a rate of 3000 times a second, in order to detect millisecond pulsars. The observations were stored on half-inch video tape and later searched for pulsars. The survey was completed in 1994.

Not only did the astronomers double the number of known millisecond pulsars, but they made some amazing discoveries along the way — including the nearest millisecond pulsar to the Earth.

Expanded knowledge

Millisecond pulsars are now implicated in a wide range of phenomena. For example, despite their tremendous speeds, they're remarkably stable and rival the accuracy of atomic clocks currently used as standard time sources. Several X-ray sources are now believed to involve mass falling onto a millisecond pulsar from a bloated red giant star. The stability of the pulse periods has allowed astronomers to check the validity of Einstein's theory of General Relativity, for which Russell Hulse and Joe Taylor received the Nobel Prize in physics in 1993.

One of the most bizarre discoveries has been that some millisecond pulsars have planets. The discovery was made by analyzing the long-term behaviour of the pulsars' rotation. As a planet orbits a millisecond pulsar, its gravity causes the pulsar's period to alter rhythmically. Pulsars with systems of up to three planets have now been found. This discovery is a major piece of evidence that planets exist outside our solar system.

Do astronomers understand pulsars yet? Since the initial discovery of pulsars in 1967, these strange stars have lead astronomers across the galaxy searching for more of them, and for the answers to the questions they raise. But as Dr Manchester puts it, "I think the thing that makes pulsars really interesting is that every few years, something totally unexpected turns up. The discovery of pulsars themselves is probably the best example, in that they were discovered almost totally by accident."

The trend has continued over the last three decades: pulsars, millisecond pulsars, 'Black Widow' pulsars, and now pulsars with planets. What waits around the corner is almost impossible to guess, but one thing is for certain: the story of these 'radio stars' isn't finished yet. ❖

LITE AND SAFER FLIGHT IN SPACE

Late last year, NASA's *Discovery* shuttle was used for orbiting mission STS 64, on which were performed a number of very interesting experiments. These included LITE, an experiment using high-powered lightwave radar or 'LIDAR' to examine the Earth's atmosphere and surface features; and a test of SAFER, the backpack thruster system designed to allow astronauts to return to their spacecraft in an emergency...

by KATE DOOLAN

By an environmentalist's standards, 1994 has been an outstanding year for research on our home planet. Out of the seven space shuttle flights that have occurred this year, four of these were dedicated to studies of Earth by the use of radar, telescopes, satellites and the human eye. These extensive Earth studies are a small part of the US National Aeronautics and Space Administration (NASA) Mission to Planet Earth, which is an ongoing program to study our planet in greater detail than was possible in the past.

In September, the major payload of the STS 64 flight was the LIDAR In Space Technology Experiment (LITE), which was making its debut in space. The Light Intensification Detection and Ranging (LIDAR) instrument, which is a combination of laser and radar technology, transmitted and measured reflected light waves in much the same way as radar sends radio waves and records the 'echo'. During the flight of the space shuttle *Discovery*, LITE aimed the most powerful civilian laser ever flown in space at various regions and collected what is expected to be the most accurate data ever.

Brief pulses of light reflected off the atmosphere were received by a telescope aligned with the laser, creating a vertical profile measurement of the object. From this light measurement, scientists can determine the precise location, distribution and composition of various elements in the atmosphere such as aerosols, clouds and the edge of the planetary boundary layer.

Unlike other spaceborne sensors that passively measure radiated light, LIDAR is an active instrument that illuminates targets of interest. Because its laser light source remains concentrated and diffuses very little with distance, LIDAR can measure small, precise areas of the atmosphere and penetrate thin clouds. The quick pulses of light are in three different wavelengths, which in the LITE telescope are filtered and

measured separately when they are reflected back. The wavelength identifies the targeted particle, while the time it takes the reflected light to return determines the altitude.

The LIDAR-In-Space Technology Experiment is mounted in the space shuttle's payload bay, on an enhanced multiplexer/demultiplexer pallet attached by instrument-to-carrier integration hardware.

The LITE hardware takes up approximately 25% of the payload bay. The basic modular LITE design has eight major subsystems; laser transmitter; receiver assembly (telescope, optics, support structure and light baffle); the electronic system, which includes instrument control, digital data handling unit, engineering data system plus electronics for the optical system; the boresight assembly; a camera assembly; the Orbiter Experiment Autonomous Support Instrumentation System (OASIS 1); the experiment platform; and the active thermal control system, which includes Freon coolant lines, cold plates and quick disconnects.

Q-switched lasers

The solid state laser transmitter module (LTM) contains two flash lamp-pumped lasers (Q-switched neodymium doped aluminium garnet), which emit light at three harmonically related wavelengths — 1064 nanometres in the infrared, 532nm in the visible green, and 335nm in the ultraviolet — in a single beam. The pulses, which have a repetition rate of 10 per second, each last less than 30nanoseconds. Only one of the two lasers operates at a time; the other serves as a backup.

The laser optics comprise the oscillator itself, two amplifiers and harmonic crystals. There are three flash-lamp assemblies in each of the two laser systems. These assemblies contain a control subsystem and power amplifier modules which were originally developed for military laser systems. Energy storage capacitors which are charged by the power supplies are switched with high powered silicon controlled rectifiers. Once a data-take command is initiated, it takes approximately 100 seconds for any photons to emerge from the laser. It takes two minutes for the laser to become fully operational at its maximum lasing energy.

The LTM storage canister provides a clean environment, shielding from electromagnetic interference and active thermal control. A water loop cools the sources of heat inside the LTM through water to air heat exchange. The LTM volume is less than seven cubic metres and weighs 1153 kilograms.

Receiver telescope

The receiver assembly includes a one metre Ritchey-Chretien form of Cassegrain telescope, and an aft optics package. The telescope's overall diameter is one metre, with a length of 2.4m. The primary mirror, which has a diameter of one metre and weighs 60kg, consists of a beryllium substrate with a Kanigen overcoating and an aluminium reflecting surface. The secondary mirror is fused quartz glass with an aluminium reflecting surface.

The telescope is existing hardware which was an engineering model of the Orbiting Astronomical Observatory built by the Goddard Space Flight Center in Greenbelt, Maryland for a flight in 1968. Using this existing telescope and not building a new one saved NASA around US$8 million.

The telescope collects laser light reflected from the atmosphere and brings it into focus in the aft optics assembly, which is mounted directly behind the primary mirror. Wavelength-selective optics then separate the return signal into its three colour components (dichroic beam splitters), and folding mirrors route the energy to four detectors. The 532nm and 355nm detectors are photomultiplier tubes, the 1064nm detector is a silicon avalanche photodiode and the boresight detector is a four-quadrant, microchannel-plate photomultiplier tube.

The boresight assembly is a two axis, motor driven prism mounted on a gimbal. The motors receive their drive signals from the boresight electronics, controlled by feedback error signals from the quad detector, and redirect the laser beam to cancel the error signals. This aligns the laser beam to the telescope's field of view, so that both instruments point precisely (within 50 microradians) to the same slice of atmosphere.

The instrument controller in the electronics system handles all the LITE command and data interfaces, thus all subsystems can commanded and controlled through the controller. It monitors health, status and transfers the information to the enhanced multiplexer/demultiplexer. More than 18 real-time tasks in the controller's software perform all commands and data interfaces for the controller, as well as independent operations.

Also included in the electronic system is a data handling unit that converts the outputs from the telescope's detectors to digital data and sends it to the high data-rate-recorder and the space shuttle's Ku-band system, for downlinking. An engineering data system collects digitised data from the LITE instrument and sends it to the instrument controller. In addition, electronics modules support the aft optics assembly and boresight system, supported by a power distribution box.

The experiment platform is a flight proven orthogrid structure attached to a carrier pallet by 52 struts. The orthogrid which supports the instrument subsystems is designed to withstand thermal deformations that may affect optical alignment. The enhanced multiplexer/demultiplexer pallet is an unpressurised payload carrier provided by NASA as flight certified hardware. It connects the LITE payload to the space shuttle utilities — mechanical, electrical, command, thermal and data.

Above: Space Shuttle 'Discovery' carried a laboratory laser into space, pointed it toward Earth and beamed narrow pulses of laser light through the atmosphere. The laser — called a lidar — will measure different phenomena in our atmosphere. Opposite: Astronaut Mark Lee tests the new SAFER system 130 nautical miles above Earth.

LITE AND SAFER FLIGHT IN SPACE

The LITE camera assembly is a specially modified 35mm camera that photographs daytime cloud cover and ground tracks every 20 seconds, to help interpret the LIDAR data.

The Orbiter Experiment Autonomous Support Instrumentation System (OASIS 1) measures and records accelerations, acoustic loads, strains, temperatures, thermal fluxes and pressures during the space shuttle's ascent, orbital and descent phases. These measurements are used to assess the prelaunch and inflight effects on the LITE payload and to compare actual flight data with engineering models. The data is also used to develop guidelines for future space shuttle and LIDAR experiments.

Nine-day flight

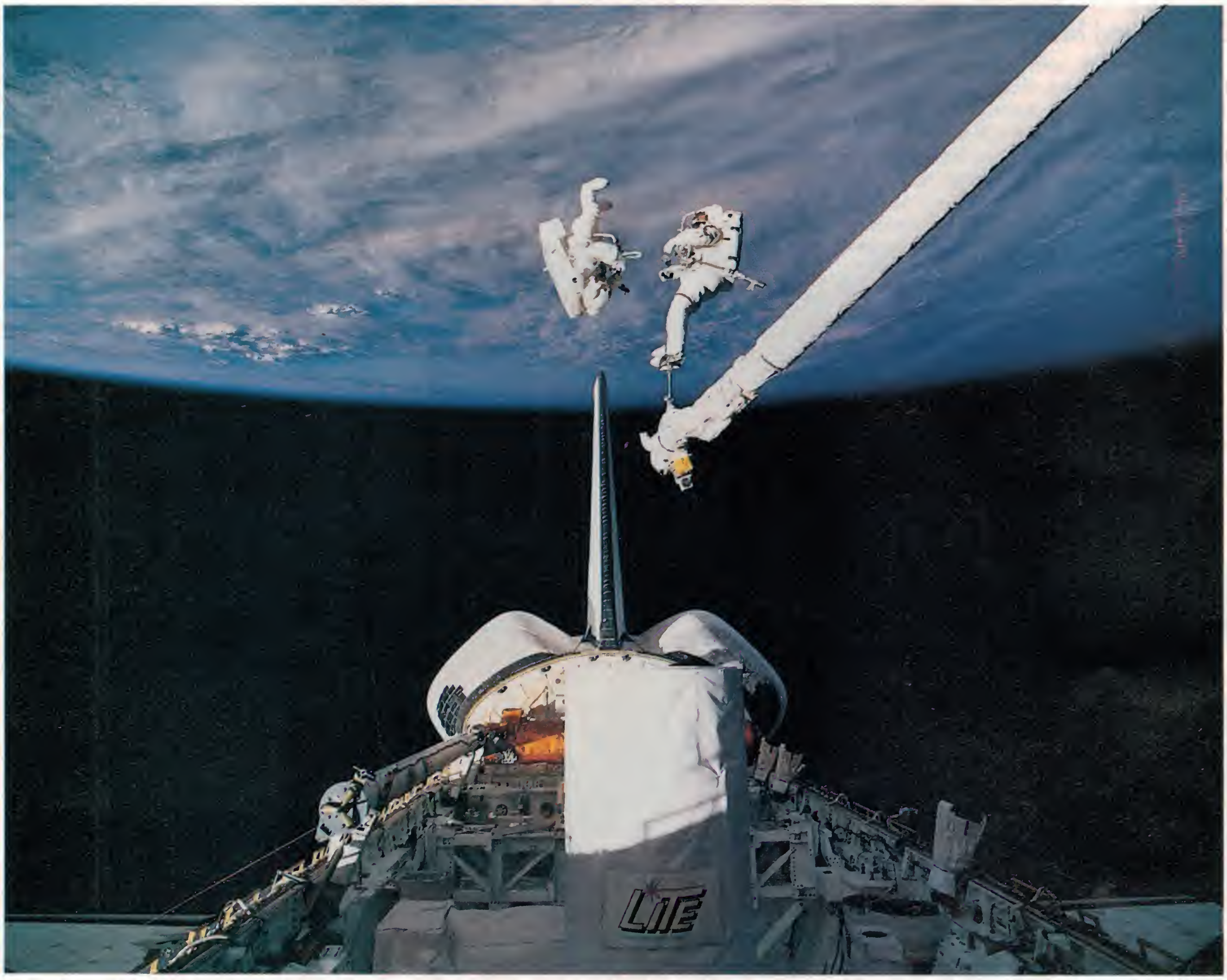
During its scheduled nine-day flight, the space shuttle was planned to orbit upside down at a 57° inclination, with the payload bay doors open and LITE pointed at the Earth. The planned orbital altitude was low — about 259km — in order to keep the laser pulses tight and concentrated as they travelled to the atmosphere and back. Ten data taking periods of 4.5 hours each were captured on a high-data-rate recorder, and simultaneously transmitted back to the science investigators on the ground.

The observations were to encompass a wide variety of atmospheric phenomena over diverse geographical areas; clouds over the western Pacific Ocean, marine stratus decks off the coast of North and South America, desert dust originating from the Sahara Desert and smoke plumes from biomass fires in South America and Africa. Tropospheric studies were to include aerosols over the Amazon rain forest, gravity waves over the Andes Mountains and reflective desert surfaces in the United States, China, Africa and Australia.

LITE was also planned to take 'snapshot' data in 15-minute intervals of selected areas to obtain specific information and to validate results from the flight. In some cases, ground sites would make simultaneous observations for calibration and later correlation. Some of the snapshot sites were located in North Africa, Europe and Australia. At times, the space shuttle needed to manoeuvre to change the LIDAR reflection angle.

'Ground truth' data was also collected by five American, Canadian and European aircraft making coordinated flights. An international ground science team also took measurements at 50 sites in 20 countries.

Most of the LITE operations were controlled by the Payload Operations Control Center (POCC) located at the Marshall Space Flight Center in Huntsville, Alabama. All LITE instrument configurations for data takes, instrument operation during data takes and the monitoring of instruments were the responsibility of the POCC controllers.



Astronauts Carl Meade and Mark Lee performing an in-space rehearsal or demonstration of a contingency rescue using the new hardware. Astronaut Lee here wears the small back-pack unit with its complementary chest mounted control unit while Astronaut Meade is anchored to the Space Shuttle Discovery's Remote Manipulator System.

The space shuttle crew were responsible for pallet activation and deactivation, visual observation of geographical phenomena, photographic coverage, initiation of certain data takes, orbiter manoeuvres, debris checks, recorder operations which includes changing tapes, troubleshooting and corrective action.

Operating modes

LITE has four modes of operation — day, when instrument settings are configured to process the return LIDAR signal without letting light from the Sun damage the optics; night, when the instrument is set to process the signal return in low light; standby, a non-lasing operational configuration; and a built in test signal mode which is a self-test simulating a data take with a signal generated by the LITE instrument.

There are also three sequences of operation (not considered modes). The 'autonomous' mode is used during a data take, independent of human control; 'multiscatter' is a crew-initiated cycling of LITE's aperture wheel through a preprogrammed series of positions; and finally 'dwell times' is used to measure cloud and boundary layer characteristics.

The Surface Directional Reflectance Experiment (SDRE) is a daylight data take to measure sea wave lengths in ocean areas. SDRE requires high-rate orbiter pitch and roll manoeuvres for 'landmark track' and 'cross track' sweeps, as well as crew photo coverage for postflight analysis. Landmark tracks require daylight, ocean and no clouds, while cross tracks require darkness, Ku-band real-time data, ocean and no cloud ceiling.

Major objectives

Three major technology objectives are geared to the development of a future autonomous LIDAR system:

- Evaluate LIDAR system operations in space — laser function and lifetime, thermal dissipation and control, alignment control, environmental levels and autonomous operation.
- Evaluate LIDAR techniques in space — signal-to-noise verification, resolution, atmospheric characteristics at different wavelengths and attitudes.
- Establish a test bed to develop other LIDAR techniques — use of different LIDAR concepts and incorporation of new laser technologies such as advanced detectors, filters and data acquisition methods.

Scientists were expecting unprecedented accuracy from the space based LIDAR — particularly in measuring clouds on a global scale. LITE is expected to yield new information about stratospheric and tropospheric aerosols, stratospheric density, Earth surface characteristics and the planetary boundary layer, which is the region of the atmosphere from where we live to up to three kilometres. The debut flight of LITE will tell scientists how clouds reflect and absorb solar energy and how the air, ocean and land exchange moisture and heat.

Aerosols and any solid material suspended in the atmosphere are mainly produced by volcanic eruptions, and to a lesser extent by human industrial activity plus some natural occurrences such as erosion and desert dust. Like clouds, aerosols are an important influence on our climate because they reflect sunlight back into space. If they increase, the Earth tends to cool. Aerosols may also increase or decrease cloud cover, which would affect the Earth's radiation budget.

Gravity waves which were studied over the Andes Mountains, occur at altitudes from 32 to 55 kilometres. Since they are the primary method by which materials are transported in the upper atmosphere, gravity waves may affect the distribution of some ozone components and temperature dynamics.

The waves are caused by wind blowing across the mountains, which create pressure fluctuations that propagate upward and increase in atmospheric density. When they become large enough, they influence winds and temperature in the upper atmosphere. Scientists need to learn more about the structure of gravity waves, planetary waves and tides in order to learn more about atmospheric density and temperature.

LITE is also expected to help define the height and optical characteristics of the Earth's planetary boundary layer. This will tell us more about its role in transferring heat, momentum and moisture from the ocean to the atmosphere. More accurate parameters for the layer would also improve weather forecasting and climate modelling.

Safety warning

Before the launch of the space shuttle *Discovery*, NASA issued an unusual warning to amateur astronomers and shuttle viewers, because the LITE payload would transmit a laser beam directly from the space shuttle payload bay to the Earth's surface.

Using the criteria provided by the American National Standards Institute (ANSI) on the safe use of lasers, NASA calculated the amount of laser energy that might reach the ground and compared it to ANSI-determined safe levels of exposure.

The study determined that observers attempting to view the space shuttle with the naked eye would not be at the risk of eye injury, nor would observers using ordinary binoculars or small telescopes with an aperture of up to 10cm. However, there was the remote possibility that telescopes larger than 10cm in diameter could collect enough energy to expose the observer to levels higher than ANSI's Maximum Permissible Exposure, for one of the laser's three wavelengths (532nm). Therefore, observers were warned that they should not attempt to view the shuttle through telescopes larger than 10cm. Capturing images electronically did not present a hazard to the observer, but highly sensitive photoelectronic detectors could have been damaged.

The launch

The LITE pallet arrived at the Kennedy Space Center (KSC) in Florida during December 1993. Another STS 64 payload, the SPARTAN 201 platform, arrived in June 1994. LITE was processed at KSC's Operations and Checkout Building. Then, along with the SPARTAN-201, it was shifted to the Orbiter Processing Facility (OPF) where they were both installed into *Discovery*'s payload bay on July 7.

In preparation for launch, *Discovery* was rolled out of the OPF on August 11 and

On the Space Shuttle Discovery's aft flight deck, astronaut Susan J. Helms handles controls for the Remote Manipulator System which was used to support several tasks performed by the crew during the almost 11-day mission.

mated with the external tank and solid rocket boosters in the Vehicle Assembly Building, before the space shuttle was moved to PAD 39B on August 18. Following a two hour delay due to thunderstorm activity in the area, *Discovery* was launched from the Kennedy Space Center at 6:23pm (local time) on September 9, into the planned 57°, 259km high orbit.

On board *Discovery* was the crew of STS 64, which was commanded by Dick Richards with pilot Blaine Hammond. Payload Commander for the flight was Mark Lee, with Mission Specialists Sue Helms, Jerry Linenger and Carl Meade. All of the crew except for Linenger had made at least one spaceflight, with Richards making his fourth spaceflight.

Before the crew went to sleep on their first night in orbit, they activated the LITE payload and immediately after, ground controllers reported that they were receiving 'terrific looking returns'.

Also activated was a new materials processing facility — the Robotic Operated Materials Processing System (ROMPS). ROMPS was the first American robotics system to be used in space. It advanced microgravity processing by using a robot to transport a variety of semiconductors from their storage racks to halogen lamp furnaces, where their crystal structures are reformed in heating and cooling cycles.

The purpose of ROMPS was to make use of the microgravity environment to develop commercially valuable methods of processing semiconductor materials. Another objective was to advance automation and robotics for material processing, in ways that may lower the costs of developing and manufacturing semiconductors.

On flight day 2, Sue Helms powered up *Discovery*'s Remote Manipulator System (RMS) arm to operate the Shuttle Plume Impingement Flight Experiment (SPIFEX), which studied the characteristics and behaviour of exhaust plumes from the space shuttle's Reaction Control System (RCS) thrusters. SPIFEX is a 10-metre long extension of the RMS arm, which measured the effects of thruster plumes.

During the fourth day of the mission, Carl Meade using the RMS arm deployed the Shuttle Pointed Autonomous Research Tool for Astronomy (SPARTAN) 201 payload, which was making its second flight on the space shuttle. The SPARTAN-201 was used to gather data on the acceleration and velocity of the solar wind and measured aspects of the Sun's corona in support of the *Ulysses* spacecraft which is currently orbiting the solar poles.

Previously used on the flight of STS 56 in April 1993, SPARTAN-201 was using scientific instruments that were used on that flight, but at a higher altitude. After being deployed from the shuttle, SPARTAN-201 floated in orbit until it was scheduled to be picked by *Discovery* before the end of its flight.

During the deployment of SPARTAN-201, problems were encountered with the *Discovery's* rendezvous radar, which was giving questionable readings. After investigations, ground controllers concluded that the bad readings were a result of the radar's late acquisition of the satellite.

Forty-eight hours after the deployment of SPARTAN-201, Dick Richards took over manual control of *Discovery* to capture the satellite, which had moved 120km behind the space shuttle. Using the flight controls on the shuttle's aft deck, Richards bought the *Discovery* to 15 metres away from the satellite. Then Sue Helms, using the RMS arm, captured the SPARTAN-201 and placed it into the payload bay. There were no problems with the rendezvous radar this time around, although ground controllers had written special procedures in case problems were encountered.

Astronaut Carl Meade checks a hose on the new SAFER system prior to a space walk test.

SAFER test

The highlight of STS 64 came on flight day eight, when Mark Lee and Carl Meade made a six and a half hour spacewalk to test several new tools for working in space. The most important of these tests was the debut of the Simplified Aid for Extravehicular Activity Rescue, or 'SAFER'.

SAFER was developed in-house at the Johnson Space Centre in Houston and is a small, self contained, propulsive backpack device that provides free flying mobility for a spacewalking astronaut in an emergency situation. It was designed for self-rescue use by an astronaut, in the event that the space shuttle is unable or unavailable to retrieve a detached, floating crewmember. An example of this could happen if the space shuttle is docked to the Mir or International Space Stations.

The SAFER unit is attached to the spacesuit's Portable Life Support System backpack, and is in essence a scaled-down version of the Manned Manoeuvring Unit propulsion backpack that was used during space shuttle flights in 1984. SAFER is designed for emergency uses only. Propulsion is provided by 24 fixed position thrusters that expel nitrogen gas. Stowed in the shuttle's crew cabin for launch and landing, SAFER can be recharged from the shuttle's nitrogen system. Its 1.5kg supply of nitrogen can provide a three metre/second change in velocity for the operator before it is exhausted. Its attitude control system includes an automatic attitude hold and six degrees of freedom. The 28-volt battery pack for SAFER can be replaced in orbit, if necessary.

Astronauts Lee and Meade evaluated SAFER through four test sequences — a SAFER familiarisation, a system engineering evaluation, a rescue demonstration and a flight qualities evaluation.

The SAFER flight operations were conducted without a tether attached to the space shuttle. The familiarisation had one of the astronauts perform several short single-axis translation and then rotation commands. They were performed with the SAFER's automatic attitude hold 'on', and again with the attitude hold 'off'. Then a square trajectory within the space shuttle's payload bay, recording the percentage of nitrogen used both before and after the manoeuvre, to compare the actual use with what had been predicted.

For the engineering evaluation, Mark Lee flew several translation commands which were a one-second thrust forward, five seconds of coasting and a one-second braking thrust. SAFER retained all measurements of the unit's performance, for study on the ground after the completion of the flight.

The 'self-rescue' demonstration had Mark Lee standing on the end of the RMS arm imparting a series of rotations to the SAFER spacewalker — Carl Meade. Meade activated the unit's automatic attitude hold system to stop the rotation and then flew back to the end of the RMS arm, which had slowly backed away. The rotations did not exceed the speed of 30° per second, a rate which was well below the design capability of SAFER. Between each test sequence, SAFER was recharged with nitrogen from *Discovery*'s nitrogen supply via a SAFER Recharge Station mounted in the forward portion of the payload bay. In addition, before the unit was switched from Mark Lee to Carl Meade, the SAFER battery was charged.

The 'flight qualities' evaluation had

Meade fly a precision trajectory that followed the bent Remote Manipulator System arm. Next, he flew a precision approach from the elbow of the arm to the aft flight deck windows of *Discovery*, establishing a hover of 30cm away from the windows.

Apart from testing SAFER, Lee and Meade evaluated a series of several new and improved spacewalking tools. These included quick release tether hooks and wrist tethers, push-button portable foot restraints, a rigid tether, modified hand rails and an articulating portable foot restraint. Another new innovation was the Electronic Cuff Checklist (ECC), which was attached to the lower arm of the astronaut's spacesuits.

Developed by the Crew and Thermal Systems Division at the Johnson Space Center, the ECC is attached to the lower arm of the spacesuit and holds more than 500 pages of information — including graphics and photographs to display on a 60 x 80mm screen. Roughly the same size as a conventional printed checklist, the one kilogram, standard AA battery powered unit is 20mm deep at its thickest point and has a memory capacity of 2MB.

The ECC also has the capability to be altered during a flight. Information can be loaded into the checklist on orbit from a laptop computer carried on the space shuttle.

Flight extended

Due to the crew carefully conserving their resources, mission managers extend the flight by another day. Operations with the LITE continued, with the crew taking four hours of data recording Super Typhoon Melissa in the Atlantic Ocean. As well, the crew observed and took some excellent photographs of the volcanic eruptions over Rabaul in New Guinea.

Used again on this flight was the Shuttle Amateur Radio Experiment (SAREX), which has been developed as an educational tool by NASA and the amateur radio community. Dick Richards, Blaine Hammond and Jerry Linenger using SAREX talked to 10 schools in both the United States and New Zealand.

After the traditional inflight press conference, preparations were begun for landing at the Kennedy Space Center. However, the crew were forced to spend another day in orbit when clouds and imminent thunderstorms threatened the newly resurfaced landing strip at KSC.

In the end, mission managers ordered the crew to land at the Edwards Air Force Base in California, at 4:13pm (local time) on September 20, after completing 177 orbits of the Earth and travelling nearly 10 million kilometres.

In closing, the author wishes to thank Debbie Dodds of the Johnson Space Center, Jim Elliott of the Goddard Space Flight Center, Kay Grinter of the Kennedy Space Center and Colonel Carl Meade for their assistance in the completion of this article. All photographs are by courtesy of NASA. ❖

Moffat's Madhouse...

by TOM MOFFAT

Our 'right' to privacy...

Recently I heard an interesting session on talkback radio, involving two studio guests: The Privacy Commissioner, Kevin O'Connor and the Telecommunications Ombudsman, Warwick Smith, discussing privacy in communications. I only came in on the tail end of this, just in time to hear a call from a university student who was majoring in cryptography.

Now, I thought, what a clever fellow, there will be plenty of work for him in this rather specialised field as more and more of our information is transmitted electronically, and hence there'll more need to protect it from prying eyes. But the student's reason for calling was to tell about a new encoding system which was virtually crack-proof, although any government would have the ability to break encoded messages if they suspected something illegal was going on.

Hey, wait a minute! What good is any cryptography scheme if it can be decoded by anyone other than the intended recipient of the message? Especially if that someone is the government? Experience over the years has shown that the average Joe in the street couldn't really care less what is in someone else's private communications. It's *governments* who want to know, because it's *governments* who have the most to lose by sensitive private communications bypassing their gaze.

The new crypto scheme allows the government to break in 'if they suspect something illegal is going on'. But who is to define what is illegal? Or the level of suspicion required? The major excuse given is to combat drug trafficking; but one suspects information gained by cracking an encrypted message might be of even more interest to the commissioner of taxation.

There is a major controversy raging here in Tasmania at the moment, concerning the alleged actions of one very senior police officer in arranging the 'tracking' of phone calls made by another senior officer. The circumstances surrounding this incident are the subject of a major police report, which the government is carefully keeping secret from the public.

The senior police officer who allegedly arranged the telephone tracking has now taken a rather sudden early retirement, helped along with a special government payment which some people allege is 'hush money'. On his way out this officer is reported to have said that the telephone tracking took place because he suspected something illegal was going on, and the word 'drugs' appeared in reports surrounding the case.

The incident opened an enormous can of worms in the Tasmania Police, with allegations of backstabbing and other funny business in attempts to sabotage promotion prospects of certain police members. It's likely we will never hear the full truth of this, but one thing that did come out was a reported statement by the retired officer that he had been given full authority to do whatever he felt was necessary to 'fight crime'. So he could arrange the telephone tracking, without further explanation, by the stroke of a pen. And that's how easy it would be for the government to monitor *your* communications, or mine.

Thought Police

Stopping illegal actions is one thing, be it drugs or hot money; but an even more sinister possibility is the prevention of illegal thoughts or words. Eh? You better believe it, what we're talking about is that hoary old subject of the Thought Police.

Australia has traditionally enjoyed an image throughout the world as a country of strong-minded independent souls who certainly weren't reluctant to express themselves. But nowadays if someone speaks their mind in Australia, and it offends the principle of 'political correctness', the Thought Police come down on them like a ton of bricks. At this stage we're only talking about spokespersons from 'correct' pressure groups, as well as certain sections of the media. But the movement is growing.

Take as an example the sad matter of Arthur Tunstall at the Commonwealth Games. He had the audacity to utter his belief that it might be embarrassing to Australia's disabled athletes for them to be seen competing alongside the country's most perfect physical specimens. This was picked up by the media and turned around so that Tunstall was reported as saying that the disabled athletes were an embarrassment to Australia.

And then it was on for young and old. Arthur Tunstall was attacked in the media from all directions, a true feeding frenzy. He was made to appear evil by the simple expedient of publishing only scowling photographs, and a campaign was launched to ruin his career and force his sacking. All because he spoke his mind.

Later we had Dame Joan Sutherland daring to say she still thought of Britain, her 'mother country', as home. More howls of outrage from the forces of political correctness. But the feeling wasn't universal, as shown by this letter in *The Australian*: 'It looks as though Dame Joan will now add the 'Tunstall Cross' to her other honours, for daring to exert her right of (politically incorrect) free speech.'

Political correctness is not enshrined in law, but it might as well be — because, in Australia at least, it parallels government policy. Consider the government's position on feminism, multiculturalism, homosexuality, native title, republicanism: an exact match with politically correct thought.

Those who don't toe the politically correct line are thus guilty of anti-government thinking. In the past, people who questioned government wisdom have been known as dissidents, and history has honoured them as fighters against oppression. Govern-

ments have made it their business to silence dissidents by methods ranging from threats and bullying to making them 'disappear'.

The first step a government can take to rid itself of dissidents is to pass laws making their activities illegal; the government then has a valid reason for stopping them.

In this light, let's reflect upon the proposed Racial Vilification Law which will make it illegal to say anything unkind about a person's race. It may become Australia's first anti-dissent law, but most of us won't worry too much because the Thought Police can't be everywhere at once. Can they?

Lately, because of numbers cuts, the police have been finding it difficult to catch speeding motorists. So they have automated the system, with speed cameras that photograph any car that passes at a speed higher than an arbitrary figure. Infringement notices are then sent out and the errant motorist pays a fine.

Scanning the Net?

Now consider the Information Highway, where people's thoughts and feelings flow back and forth at the speed of light. Every day I send and receive electronic mail on the Internet; sometimes I join a newsgroup where people toss their thoughts around for public discussion. Many times those thoughts display a remarkable lack of political correctness.

With today's wondrous modern technology, what would prevent the government Thought Police from hooking into the Internet themselves — with a little gadget that scans every passing message, looking for key words; for instance 'wog'. Anyone who used that word in public or private conversation would be deemed to be guilty of Racial Vilification, and would be sent an infringement notice along with a fine.

Not possible? Well, it certainly IS possible, and dead simple to boot. The Internet can already scan newsgroups for key words of interest to a particular user, and store any messages containing those words for later perusal. The interested user could very well be a government agency, and there are heaps of them on the Internet already. As far as I can tell there is nothing at all within Australian law to prevent people's most private thoughts being electronically monitored and acted upon by government.

Another radio interview I heard some months ago was with a fellow, I believe in Adelaide, who claimed that his private telephone calls were being monitored by Telecom; and furthermore they were being put up on a speaker in the Telecom test-room for all to hear. He further alleged that when he complained of this to Telecom, they accused him of having delusions and then sent a psychiatric nurse around to transport him to the looney bin.

A Telecom spokesman was next interviewed. He claimed that it was simply not possible for a person's private telephone calls to be monitored and then put up on a speaker in the test-room. As for the psychiatric nurse, I missed the answer to that one because I was too busy remembering telephone test-rooms, from my own years with the telephone company in the USA.

It is common practice, in test-rooms all over the world, to put telephone circuits up on speakers from time to time. This happens when you are trying to trace an intermittent fault. Because of staff numbers it is not possible to assign a technician to sit with a circuit, listening on a headset, waiting for the circuit to play up. So you put it up on a speaker, with instructions to everyone in the test-room to try to log what happens when the circuit goes bung.

There are some circuits known in American telephone jargon as 'bad actors'. These circuits display maddening intermittents, and they're usually private lines leased to important customers who are threatening to cancel their service if the thing isn't fixed. Bad actors are almost always kept on a speaker unless the speaker is being used for something else.

Now I have visited several Australian test-rooms over the years, and I have seen, and heard, speakers in use for exactly the same reasons we used them in America. Why, then, should this Telecom spokesman have denied completely their existence? Couldn't he have just confirmed that a speaker was in use, and explained why?

Maybe he was worried about some of the other things that go on in test-rooms, at least in the USA. Sometimes a technician, on night shift, alone, gets a little bored. Sitting in front of him is this great panel filled with telephone circuits, and sitting on his ear is a headset. He takes a plug in his hand and fiddles with it, and then idly runs it along a row of circuit connections. Any busy circuits make a click in his headset, and he plugs in. And you're being monitored. Not maliciously, just for something to do. And the technician smiles... he hears some strange things, sometimes.

In one telephone office where I worked there was a special testboard for local subscriber circuits. It had a big meter so you could test for shorts or grounds or leakage, and it had the ability to send a 600 volt jolt up the line to clear out water seepage. And, of course, it could listen to any sounds on the line, and put them up on a speaker if necessary.

This interesting gadget did not need someone to put a 'shoe' into the main distribution frame to break into a circuit; it could simply dial it up, and it was yours. Sometimes when I was called out at night for a trunks fault, I'd turn up at this exchange to find the night-shift techs had dialled up the local whorehouse line and put it up on a speaker, so they could monitor people who rang to make bookings. Again, just to kill the boredom.

But what if this kind of device fell into the hands of a government or a political group? The possibilities are boundless. Note that we're talking about telephone exchanges of 30 years ago. There's nothing to suggest that these capabilities would have been abolished in modern exchanges; on the contrary, sophistication will have increased many times over.

So this whole business is somewhat worrying. Our political leaders have taken it upon themselves to correct our thinking (as well as re-educate our judges) under a process which has become known as 'social engineering'. Those who resist publicly are savagely attacked; those who resist in private usually get away with it. But the technology now exists to silence the private dissenters as well.

Come to think of it, it may be decided that I require re-education once this column becomes public. Or my phone line will develop some strange clicks and plops. Or maybe — as happened in the old Soviet Union — they'll just commit me to the real madhouse. ❖

THE DIGITAL PRINTING REVOLUTION

After 130 years of printing with conventional technology, the reproduction of a continuous-tone image on paper is undergoing a fervent revolution as digital technology makes its impact. Or, looking at things from another angle, desktop publishing is being bestowed with a whole new range of reproduction quality levels.

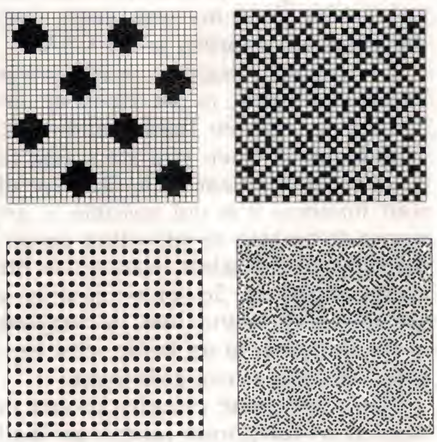
by BARRIE SMITH

For many, the acronym 'DTP' has often meant *Don't Try Pictures*, rather than DeskTop Publishing. Affordable computers, accessible desktop publishing software and laser printers using PostScript imaging promised much, but have delivered around 20% below the expectations of many.

The dream of writing the text, creating the pictures, then collating the whole into a publishable, saleable book has been in many minds since DTP first became possible, with the introduction of the first Macintosh and the initial version of PageMaker software around 10 years ago.

The theory was sound: take your photographs, draw your diagrams and translate them into digital form. The pictures, merged with text, could then remain as digital bits and bytes until the creation of a final, photo-sensitive printing plate.

The reality also was sound, and harsh: images were found to consume mammoth amounts of computer memory, and called for prolonged processing times.



Comparison of conventional halftone dot structure and Agfa's CristalRaster FM screening.

Required still was an intermediate stage — usually a bromide print — carrying all the text and images, conformed and collated for the final plate making. Colour only allowed these problems to escalate.

Via the all-digital route, it was found to be actually more costly to produce a pre-press illustration from a photograph than to use traditional methods. For its part, the latter approach has always demanded careful procedures and skilled labour...

Quite recently, though, a number of methods have appeared, employing digital processing, which are revolutionising the reproduction of continuous-tone images — particularly photographs.

Heidelberg's GTO-DI press completely bypasses conventional film making. The full page digital data goes directly from the computer to the press, inside which the four or five colour plates are imaged simultaneously and impressions made on the paper.

Agfa's CristalRaster

Today, the offset printing press is almost universally used for the production of magazines, books, etc. Supporting it, commercial, economic halftone reproduction of photographs and other continuous-tone originals has always relied on some form of *screening*.

In recent years computer generation of halftone screen renderings has often resulted in unwanted artefacts, such as rosette and moire interference patterns, and loss of detail.

But thanks to the advances in photography, electronics, printing methods and innovative software, a new method has emerged that offers the creative benefits of desktop page construction, coupled with the productivity of offset printing.

Agfa's CristalRaster process can equal the quality of direct gravure printing, yet does not call for massive computing power nor lengthy image processing. The result is photographic quality printed material, using films output on PostScript imagesetters.

The approach is radically different to traditional methods and uses a so-called FM (frequency modulation) technique, sometimes known as *stochastic* screening.

With conventional screening, the halftone reproduction of a continuous-tone image consists of an arrangement of equally-spaced dots, with sizes that change proportionally to the tone value of the original.

The Agfa company manufactures imagesetters which implement screening with CristalRaster technology.

With the new FM screening, all halftone dots have the same very small size, but their number per unit surface area (i.e., their density or 'frequency') varies according to the tone value to be reproduced. Their spatial distribution is also carefully randomised.

Since the CristalRaster microdots are much smaller than conventional halftone dots, the technique can be regarded as 'screenless' printing.

Until now, photomechanical implementation of screenless printing has never been widely seen because of the difficulty in controlling the size of the microdots throughout the process. But thanks to the high quality of today's laser imagesetters and intelligent digital algorithms, Agfa has overcome this problem.

Halftones generated with CristalRaster are totally free of moire patterning, and when the technology is used in conjunction with correctly prepared plates and multi-colour presses, the printed images appear to be of continuous tone or photographic quality.

Perhaps the most striking advantages offered by CristalRaster are realised by colour printers. For the creative DeskTop Publisher, nothing more is required than to specify the technique for film output from the imagesetter bureau.

One other advantage of the increase in available detail is in the areas of grey values. In conventional screening, the maximum number of greys is determined by the relationship between recorder resolution and line screen ruling. With CristalRaster this boundary is removed — you will always have 256 grey levels. Coupled with this is the advantage that greater detail creates better edge definition.

CristalRaster is used to the point of plate making. From this point on, the printing process relies on conventional machinery, inks, etc.

In similar fashion, Hell-Linotype's approach to digital screening (Diamond Screen) attacks problems of moire, rosettes and limited tonal reproduction. Note in the left image how clumps of rosettes disturb single colour areas. Both are blow ups from printed images.

Diamond Screen

Another approach, drawing on the same basic solution, is taken by Linotype-Hell, a leader in printing technology for many decades.

Linotype-Hell's view is that 'the day of the classical screen is drawing to a close...' The firm's Diamond Screen process attacks the reproduction of high quality colour images, with the aim of equalling the photographic image — again via frequency modulated random dot generation.

Two problem areas of reproduction in particular were given attention: the production of unwanted moire pattern effects in patterned image detail, and the disruptive rosette (or clumping) artefact, often seen in areas of continuous tone.

Diamond Screen is compatible with the PostScript language and, as in CristalRaster, the dot formation is on a carefully calculated random basis.

In plate making, meticulous care must be taken with exposure of the high resolution plate material — individual spot size can be as small as 15um (micrometres); by way of comparison, a screen dot in a conventional 150 lines per inch screen can be as large as 27um. In Diamond Screen, up to 450,000 dots can be placed within an area of a square centimetre.

Two imagesetters manufactured by Linotype-Hell are specifically set up to output plates imaged with Diamond Screen, and at high speeds.

Heidelberg's GTO-DI

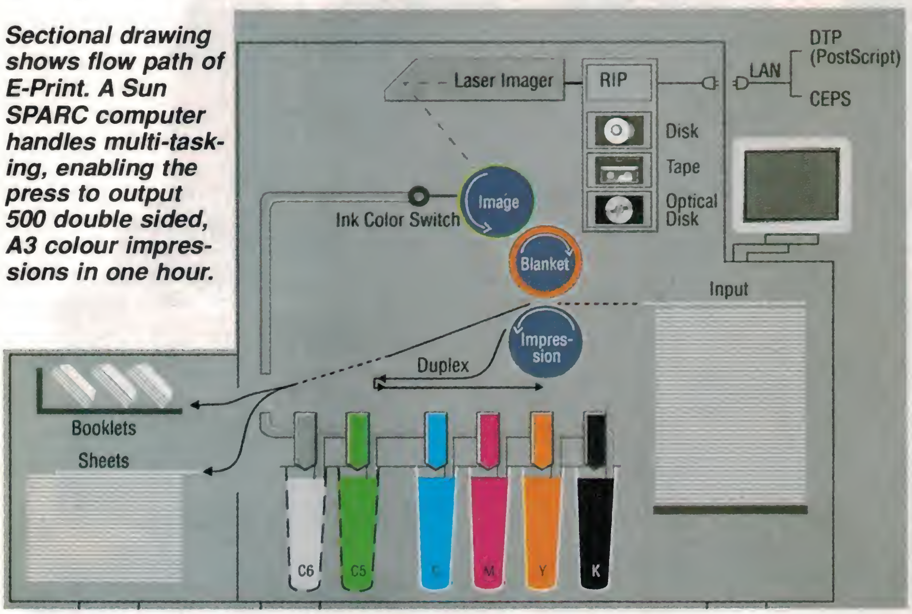
Well known for over 100 years as the producer of precision printing machinery, Heidelberg is also a major force in digital imaging, having pioneered the development of a direct imaging press.

The attraction of Heidelberg's GTO-DI Multicolour Direct Imaging Press is its ability to output four- or five-colour offset publications, up to A3 proportions, in short runs.

The machinery completely bypasses conventional film and plate making. No film is made, nor is there any intricate positioning or separate plate making required. The full page digital data goes directly from the computer to the GTO-DI press. Inside the press, the four or five plates are imaged simultaneously, in register.

The system is sufficiently cost-effective that commercial quality two, three, four or five colour printing can be made in runs as short as 400 impressions. In some ways, the GTO-DI hardware could almost be considered a five-tonne laser printer — the digital data travels directly to the printing press.

Sectional drawing shows flow path of E-Print. A Sun SPARC computer handles multi-tasking, enabling the press to output 500 double sided, A3 colour impressions in one hour.



THE TRADITIONAL METHOD

Any photograph to be reproduced is re-photographed by a process camera onto film, screened through a glass plate overlaid with a an organised pattern of dots. The dots, when committed to the printed page, allow the transference of subtle shading. More recently, digital 'scanners' have been used to perform the same job as the process camera.

A full-colour photograph requires a distinct film 'separation' to be made in each of three primary colours — Cyan (C), Magenta (M) and Yellow (Y), often with another film exposed to capture the scale of monochrome tones (Black or 'K'). Reproduction on the printed page is usually referred to as a CMYK process.

An extended juggling act is undergone to achieve the smallest possible dot, most suited to the absorption characteristics of the paper, combined with sensitivity to the angle of the screen dots in the various colour records. A mix of incorrect, clashing angles can produce the unpleasant moire and rosette interference pattern effects.

Heidelberg's approach to direct imaging uses a non-photographic, direct-to-plate imaging technology, mounted on the press. No film or chemicals are used, and no intermediate steps are undergone. The printing plates themselves are unconventional and designed for use with waterless offset inks: the top layer is silicon which repels ink. This overlays a carbon layer, and a base of high grade aluminium.

Direct imaging works by a technique called *ablation*. Wherever ink is to be laid down, a laser is used to remove or erode the silicon and carbon layers from the plate, thereby exposing the underlying layer — which accepts ink.

An infra-red laser is used in the plate imaging, with 16 lasers allocated to each plate-carrying cylinder. Each laser is connected to an optical fibre, carrying the light to an array of lenses uniformly mounted about 10mm from the plate and spaced across its width.

Each printing plate costs around $14 — a third the cost of conventional types, when ancillary expenses are taken into account. Potential print runs from the plates are up to 20,000 or more impressions. The plates themselves can be re-used, but considering their cheapness this is rarely done.

The technique is claimed to be 30% cheaper and 40% faster than conventional methods. A typical production run, from plate loading through 'burning' to final printed output can consume as little as 35 minutes for a four-colour, 150 line per inch, 1000 sheet job.

Resolutions of 2540 dots per inch can be achieved, but 1270dpi is a more practical level, allowing smaller data file sizes. A set of 1270dpi plates can be simultaneously imaged in 13 minutes.

MORE INFO FROM AGFA...

To help demystify DTP, Agfa in the US has produced four excellent booklets (20x25cm in size, full colour) which will go a long way to settling shaky DTP tempers.

Volume 1, *An Introduction to Digital Color Prepress* (32pp) takes you through such topics as layout, image manipulation, monitor calibration, halftone screen angles and proofing.

Volume 2, *Digital Color Prepress* (32pp) explains the much-misunderstood scanning process and how software can lift the quality of a scan. The mysteries of RGB and CMYK are revealed, and displayed in excellent colour reproductions.

Volume 3, *Working with Prepress & Printing Suppliers* (24pp) in many ways retraces some of the ground of the earlier two, but offers useful advice on how to deal with prepress and printing houses.

Volume 4, *An Introduction to Digital Scanning* (42pp) will help newcomers disentangle the complexities of digital scanning. Topics include colour theory, resizing bitmaps, scanning resolution rules, histograms and tone curves, tone correction, image sharpening. Such puzzles as whether to scan an image at 300dpi or 2400dpi are also answered.

The four booklets, all together, should answer many questions in DTP and save embarrassment when things go wrong. By the law of averages and the ever-increasing complexities of hardware and software, things will still go wrong — but at least you'll now be able to put a name to the problem!

Available at $50 for the set of four, they can be ordered from Ms Sheridan Johnson, Business Group Graphic Systems, Agfa Gevaert Ltd., 372-394 Whitehorse Road, Nunawading, Vic 3131. Phone (03) 264 7711, or fax 03 264 7890.

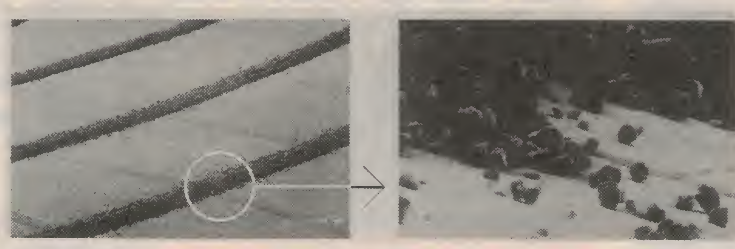
Worldwide, there are some 100 GTO-DI installations operating, including Australia.

Indigo's E-Print

From Israeli company Indigo comes the revolutionary E-Print Press, claimed to be the world's first digital offset colour machine.

Sydney agent ODIS — owned by the Toyo Ink concern — predicts that there will be at least 12 installations across Australia by the end of 1995. Sydney bureau WYSIWYG has already ordered two. At a million dollars per installation, E-Print is a major committment.

One of the problems is training personnel to drive the E-Print: as a combination printing press, image setter and high-end computer system it calls for mechanical sense, plus electronics and computer skills combined with printing knowhow. The unit can be fed from most computer platforms. The units I saw operating were Ethernet linked to a Macintosh network.



A comparison chart prepared by E-Print's developers, showing other methods of digital imaging. E-Print uses ElectroInk, a Toyo Ink development, which is a liquid toner (understood to be a world first).

The E-Print press is virtually an amalgam of a colour laser printer and a conventional sheet-fed offset printing press. Once the PostScript page file arrives, a UNIX-based Sun SPARC computer buffers the data, ready for the actual printing process.

The 2GB (gigabyte) hard drive, which is expandable, is configured to handle three jobs simultaneously — loading, processing the page image and printing.

The image memory, with 70 patents on its design, is one of the key components. The system operates at 200Mb/s (megabits per second) — twice the speed of optical fibre.

Once in memory, the memory drives the laser. A latent image of each colour is written on the Organic Photo Conductor (OPC) — a photo-reactive drum, similar to a plate cylinder. The drum is charged to 1700 volts wherever image information is required. An ink injector floods the drum with liquid toner. The balance of unused ink is returned to storage tanks. After 'inking', the image

Continued on page 97

DOWN AMONG THE MICRONS

Sydney output bureau Prestige Colour claims to be the world's biggest PostScript operator. Director Jim Gard enthusiastically supports the technological approach offered by CristalRaster to such a degree, he sees "absolutely no reason why we should have screens at all!"

He suggests, however, that caution should be adopted in the actual plate making from film exposed with the random-dot process: exposure is critical, as is maintenance of a dust-free environment. But, with quality assurance and quality control in place there is really no problem, nor need for special equipment.

Prestige's deployment of CristalRaster can produce a microdot size as small as 11um. Gard adds that a particle of ink is 10um, "so you can't go below that!"

He adds that CristalRaster is much easier on the press, and more flexible — as well as creating smaller file sizes. A typical 150-line screen, A4 page in four colours can add up to 40-42MB when screened conventionally; the same image via CristalRaster produces a file size of only 8-12MB.

When I Think Back...

by Neville Williams

Readers have their say: Omegas large and small, Archie Caswell, and the H.K. Love/Kingsley finale...

Having been holed up in hospital for several weeks by what appeared to be a belated encounter with a renegade 'bug', I am now faced with a stack of unanswered letters from readers commenting on matters recently raised in these columns. Please be patient if it takes a while to catch up. Either that, or blame the aforesaid Cytomegalo virus!

Without further ado, then, let's look at the mail. Writing from Upper Hutt in New Zealand, Terry Parritt recalls his days as a teenage wireless enthusiast in Birmingham UK, when it was possible to pick up unwanted 1920's style receivers for a few shillings apiece! These, along with various ex-government bits and pieces, were available from local 'junk' shops.

In those days, he said, it was common practice in British circuit diagrams to denote resistance values with a lower case or small omega (ω) to signify ohms; by contrast, an upper case or large omega (Ω) would signify a resistance expressed in megohms.

Such being the case, our remarks in the October, 1993 issue about the 'Tropadyne' circuit were inappropriate. At the relevant time, the resistors shown as 0.5Ω and 1.5Ω would have been read as 0.5 and 1.5 megohms — as intended by the designer.

Also from New Zealand comes an excerpt by author John Stokes from the NZVRS Bulletin, Volume 14, No.2, Aug '93. In questioning our self-same comments about the 'Tropadyne', he mentions other examples of confusing terminology over the years — a case in point being substitution of the letter 'm' for a small omega, or as an abbreviation to signify Megohm/million or Milli/thousand — a mere 1000-1 discrepancy!

Thanks Terry, and thanks also John. I suspect that the convention involving a big and little omega was observed less in this country than in UK/NZ literature. But, whatever the reason, I missed it!

Archie Caswell

When I set about to prepare a story for 'When I Think Back', there's no telling where it will finish up after historically-minded readers' interest has been focussed on the subject.

Prior to writing his story for the January/February 1995 issues, Archie Caswell was completely unknown to me. His potential biographical interest arose from the fact that, as a one time radio serviceman and hobbyist from rural Queensland, he had managed to contrive ingenious — and forbidden — radio receivers in a Japanese POW camp, from unlikely oddments, thus significantly boosting the morale of his fellow prisoners.

A photo of Howard K. Love, sent to us recently by a reader.

While essentially the story of one man, it became evident from the telling that Archie Caswell had been aided and abetted by unnamed fellow prisoners, who were prepared to scrounge radio oddments at considerable risk to themselves. It was also evident that other technically resourceful prisoners had also managed to intercept radio transmissions by setting up illicit equipment in other camps.

How I came by the Caswell story is explained in the January issue. But, to my surprise, an inquiry about Archie's exploits reached me prior to publication of the January issue, while I was still flat on my back in hospital. Once uncovered, the Archie Caswell story had clearly been relayed on the amateur historians' 'Grapevine' across the world!

In a letter from 16 Cloncurry St, London SW6 6DS, Sibylla Jane Flower said that she had personally been researching a book on the history of Japanese war prisoners, particularly on the Burma-Siam Railway. She had interviewed surviving radio operators during a recent visit to Australia and the Arch Caswell story, reportedly due for publication in *EA*, would be very relevant to what she had in mind.

In short, Arch Caswell might well become the central figure in a book about a different kind of war hero — one

wielding a circuit diagram and a soldering iron!

Howard Kingsley Love

On the other hand, one of the most satisfying stories I've prepared in recent months was that on Howard Kingsley Love, the founder of Melbourne's Kingsley Radio (see *EA*, July-August, 1994).

This story emerged as a natural sequel to the earlier story of Lay Cranch, but posed a very real problem: HKL was widely known throughout Victoria as a radio amateur and technical writer, a pioneer broadcaster, an electronics engineer and an equipment manufacturer. What was missing, or so it seemed, was the usual assortment of biographical articles published during the course of his career. That he had accomplished much was in no doubt; our problem was to document exactly how, when, where and why!

Fortunately, we were able to assemble a few snippets of basic information about HFK and other pioneer Victorian amateurs from early magazines, which slotted in with the recollections of a reader from way back, George Neilson (VK3TES), who had worked for years in the Kingsley factory.

By merging George Neilson's story with that of Lay Cranch and scattered references in postwar magazines, were able to present a reasonably cohesive biography of Howard Kingsley Love, extending from his early years as a radio amateur to his sudden and unexpected death in 1948.

The exercise took on a much more personal quality on receipt of a letter from HKL's daughter, Kathryn Lechte — also unknown to me prior to the exchange.

Here is what Mrs Lechte wrote:

I was pleased to read Mr Williams' recent article, as H.K. Love was my father. For years I have been hoping that someone would recognise my father's expertise as one of the original ham radio pioneers.

I have often contemplated writing down things I remembered about his life, but my knowledge of the workings of Kingsley Radio was limited as my father died when I was in my early 20's and coping with a young family.

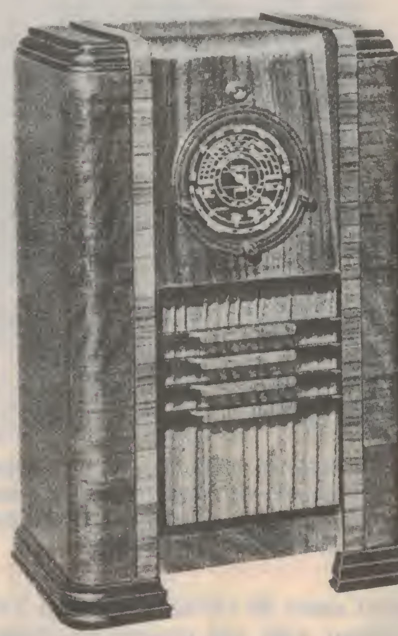
To read about the staff and how the business operated brought back many memories of the 1940's and I am only sorry that we lost touch with so many staff and friends through the trauma of my father's death and the winding up of the business.

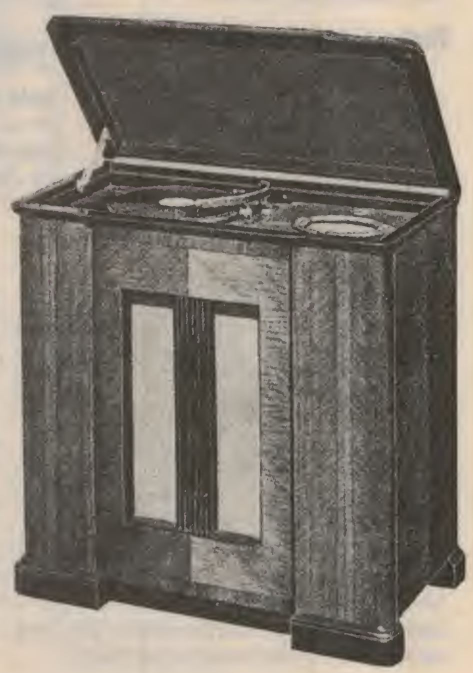
My father's wireless room was always the hub of much activity, epecially when a 'CQ' brought in overseas hams on the loudspeaker, often keeping the family awake until all hours.

Morse code was an integral part of radio in the 1920's and my mother was often brought into the radio room to help interpret some distant contact, as she had been trained as a telegraphist in England.

VK3KU and VK3BM were two well known callsigns in those days. When my father died at age 52, a great pioneer of radio was lost prematurely.

Kathryn Lechte (50 Bowden St, Castlemaine, Vic 3450)





A range of Kingsley receivers as advertised for the 1938 market. At upper left is the K 45D five valve dual wave console priced at 19 Guineas. Lower left is the K50 CD five valve dual wave console which featured a Kingsley high fidelity amplifier and was priced at 25 Guineas. Centre is the six valve K60 CD console which cost 30 Guineas. Upper right is the K50 MD Mantel Model five valve dual wave receiver modestly priced at 17 Guineas. And at lower right is the six valve dual wave K60 DP radiogram priced at 65 Guineas.

It is indeed good to realise that the articles in the July and August 1994 issues can provide a basic biography of Howard Kingsley Love, which can be embellished by any other information which may come to hand. Kathryn Lechte would have personal memories of H.K.L. in their family home.

Other readers, as below, have contributed further information.

Writing from Mt Gambier in SA, John F. Harris says that he became an amateur operator after the war and invested in a Kingsley AR7 receiver as part of his station equipment. At the time, Kingsley Radio offered a service whereby owners of an AR7 could return the LF 'Band A' coil box to the factory and have it converted into a 10-metre bandspread coil box.

By way of further up-dating, he personally replaced the original 6U7-G RF amplifier with an EF50 and the 6K8-G converter with an ECH35. The end result was was 'quite a receiver', he says, which kept him going until he eventually replaced it with a BC-348.

John recalls that when he took in his Band-A coil box, someone at the factory had shown him a prototype 6-metre converter. To the best of his knowledge, and sadly, the converter had never reached the commercial market.

Broadcast receivers

Writing from Latrobe in Tasmania, at the ripe old age of 81, Jim Davis VK7OW says that he has been around for long enough to remember and collect a fascinating array of wireless memorabilia, including some branded Kingsley.

As a collector, he has an array of SW receivers and transceivers, 35mm sound film equipment, antique radios from 1914, phonographs from 1897, broadcast mikes from 1926, etc. I may have more to say about Jim's actvities in another issue.

In the present context, Jim's memories of HKL go back to the late 1920's, when they met at Burnie. HKL had been playing records and answering technical questions over broadcast station 3LO in Melbourne, and had agreed to supply a mutual friend at Burnie with 'the best record player that money could buy'!

Said to be unique to 1932, the de-luxe receiver built for a friend in Burnie by Howard Love. Unmarked and capable of magnificent sound, the set is now owned by Jim Davis of Latrobe, Tasmania.

What follows reminded me very much of the 'York' line of receivers released by Reliance Radio in Sydney around 1934. Designed to feature annually at Sydney's Royal Easter Show, the 'Yorks' were virtually custom built, using the best available components, circuitry and cabinet ware.

Jim says that, back in 1932, the Kingsley special receiver was unique. It stood about 5ft (152cm) high and 3'6" (106cm) wide and covered the broadcast and two shortwave bands, with a sensitivity (RF gain) control, phono-radio switch and audio control. A push-pull output stage drove a 12-inch (25cm) Rola Auditorium electrodynamic speaker, with a separate power supply to excite the field.

Opening the lid revealed a then-modern Astatic crystal pickup which, at the time, lacked offset to counteract tracking error. But not in *this* player; Howard Love had fitted it with a 'parallelogram' type arm which completely cancelled tracking error and which anticipated the Garrard X-100 parallelogram arm by 49-odd years!

Jim says the sound was 'out of this world' to a hobbyist who owned a home-brew three valve TRF set, built on a breadboard with plug-in coils wound on UX valve bases.

But, adds Jim Davis, "the proverbial wheel turned the full circle during the next 20 years". The proud owner of the receiver passed away and left it to a relative who had no real use for it. Jim Davis was able to buy it for his collection — the cabinet in original condition, unmarked! (see picture).

Jim has been in touch with Kathryn Lechte and has photographs of typical Kingsley receivers from the 1930's, and also a 16mm colour film of the Kingsley factory showing various stages in receiver production.

The final chapter?

Writing from Woodend in Victoria, Mr H. Martin recalls a career with a number of electronics companies in the Melbourne area. In the process, he mentions that he may well shared in the final chapter of the Kingsley saga — a tantalising statement in the present context.

Mr Martin arrived in Australia from Germany in 1952, and worked in Tasmania for a year under a labour contract with the HEC. He was transferred to Melbourne in the following year to assemble and wire Byer tape decks.

In the meantime, he had to cope with learning English, and to *Radio & Hobbies* (as we were then called) went the honour(?) of the most obscure phrase he encountered. To *have* an argument or get involved in one was logical enough, but the idea of 'Buying an Argument' defied all linguistic logic!

As it turned out, Byer had sub-contracted some of the tape recorder work to the Aegis Manufacturing Co., and he ended up in Aegis' busy little 20-person factory in St Kilda Road, opposite the Shrine — virtually the manufacturing arm of J.H. Magrath's parts store in Little Lonsdale Street. He adds:

Magrath's shop was a virtual Mecca for a radio enthusiast. It was the first and

An Astatic crystal pickup from the early 1930's. The original rigid arm has been cut and rejoined using parallelogram rods, which substantially obviate tracking error as the pickup moves across the record.

only self-service radio shop for years, selling to home constructors for little more than trade prices. (Employees of Aegis got a further 10% off!)

At Aegis, Mr Martin got to know the Product Engineer 'Chuck' Van Scoy and gained an understanding of Aegis products, as well as tape recorders.

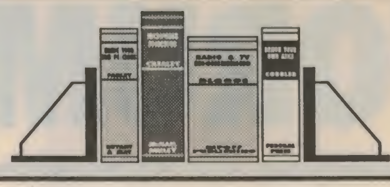
One memorable weekend, he helped clean out the cellar to gain extra storage — to discover that it contained workshop equipment that had once belonged to Kingsley Radio, including presses for extruding iron cores. In conversation, Chuck told him that Kingsley had been pushed into bankruptcy by the National Company of America. National was said never to have granted a formal licence covering wartime manufacture of the AR7 receiver, and had supposedly laid claim to all wartime profits made on the Australian version.

Following the sudden death of Howard Love, it was presumably not a contest for which the surviving board members would have had any relish; hence their hasty decision to wind up the enterprise.

According to our correspondent, the contents of the cellar he cleaned out was what remained after Mr Magrath had taken what he could use in the Aegis Factory. The larger presses and other heavy machinery was acquired by Anderson & Roudie — A&R, the transformer manufacturers.

To Mr Martin, dispersal of the hard-won factory equipment that had been assembled by Kingsley to produce their unique tuning system had to be the final chapter in the saga! ❖

NEW BOOKS



Linear supplies

SIMPLIFIED DESIGN OF LINEAR POWER SUPPLIES, by John D. Lenk. Butterworth-Heinemann, 1994. Hard covers, 241 x 161mm, 246 pages. ISBN 0-7506-9506-4. RRP $62.95.

This latest book from well known US technical author John D. Lenk is devoted to the design of linear power supplies, using both discrete components and IC regulator chips. It's one of a series for design engineers, sponsored by the popular US magazine *EDN*; although as the first word of the title implies it takes a basically 'practical' approach, with maths kept to a minimum.

The first three chapters deal with linear supply basics, the use of heatsinks and discrete feedback regulators. It then progresses to regulators using dedicated ICs and op-amp comparators, linear supply testing techniques and use. Finally there's a very large chapter, amounting to virtually the second half of the book, which presents quite a large number of practical design examples — many of them taken from applications material generated by device manufacturers.

Overall it provides quite a lot of useful information on the basics of linear power supply design, although I did find the text explanations rather sketchy and unsatisfying in places. In a few areas the accompanying diagrams are also a bit misleading — including the first few in chapter one, which show the outputs of basic half-wave, full-wave and bridge rectifiers as all identical(!), and having the waveform of a completely unfiltered full-wave rectifier, even though they're all shown with full C-L-C filter circuits...

However those who haven't much experience with linear supply design may still find it of value, particularly as a primer for more in-depth study.

The review copy came from Butterworth-Heinemann Australia, of PO Box 5577, Chatswood 2057. (J.R.)

Motor control

ELECTRIC MOTORS AND CONTROL TECHNIQUES, by Irving Gottlieb. Second edition, TAB Books, 1994. Soft cover, 188 x 234mm, 294 pages. ISBN 0-07-024012-4. Recommended retail price $49.95.

Irving Gottlieb is well known for his books on regulated power supplies, so it's not surprising to see him tackle the topic of motor control. The book follows a traditional approach, but Gottlieb's writing style makes the text both frustrating yet fascinating. For instance, when discussing stepper motors, he writes '...the common operational mode is that a discrete quantum of angular rotation occurs in response to a pulse.'

Writing style aside, this book has much to offer the student, the professional engineer or anyone with an interest in motors, large or small. It starts by examining basic motor and generator action, with brief descriptions of the electrostatic motor and a microscopic motor, along with the more traditional types.

Following chapters cover the classic AC and DC motors, with electronic control techniques finally surfacing in chapter 4. Here the author discusses a range of control methods used with commutator-type machines, with non-commutator machines following in chapter 5.

Control of stepper motors and small DC motors is presented in Chapter 6. Most circuits here are based around ICs, including the well known LM3524.

The last two chapters occupy about 50 pages and include 'non-classic' motors such as the variable reluctance stepping motor and a discussion of the electric car.

The book has numerous diagrams and circuits and to this reviewer, it would make valuable reading for anyone working in this field.

The review copy came from McGraw-Hill, PO Box 239, Roseville 2069. (P.P.)

Building receivers

RADIO RECEIVER PROJECTS YOU CAN BUILD, by Homer L. Davidson. Tab Books, 1993. Soft covers, 233 x 187mm, 312 pages. ISBN 0-8306-4190-4. RRP $39.95.

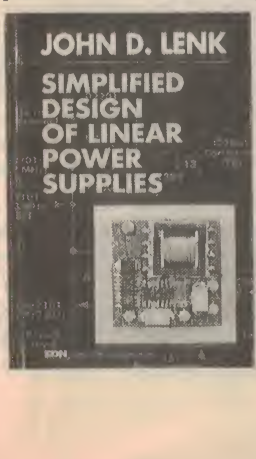
Homer Davidson is clearly someone who still enjoys experimenting with electronics and radio circuits himself, and he seems to have made every effort to pass on this enthusiasm to the reader. It's the kind of book which anyone with even a smidgeon of latent curiosity about electronics will find hard to resist.

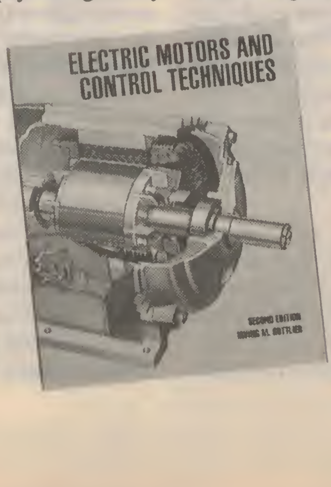
Apart from an introductory chapter on basics such as reading schematics, construction techniques and troubleshooting, and a closing chapter on making dials and obtaining parts, the rest of the book is devoted to the presentation of its radio receiver construction projects. There are about 25 in all, ranging from a variety of crystal sets through simple regenerative models, to a direct-conversion model and finally a fairly basic but practical superhet for shortwave. Most of them are based on discrete diodes and transistors, or commonly available ICs like the ZN414 or LM386 — although he also throws in a few circuits using one or two valves, such as the old 1S4 battery pentode or the 12AT7 double triode...

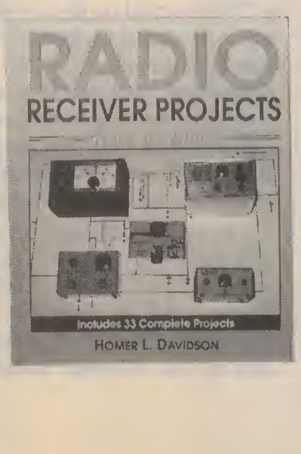
As you might expect considering the number of projects presented, the coverage is a little brief at times. But overall, there should be enough practical information to allow most people to build the circuits with a high chance of success.

For anyone keen to discover or rediscover the joys of experimenting with simple radio receivers, then, it would make an excellent guide.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069. (J.R.) ❖







FORUM

Conducted by Jim Rowe

Problems playing CDs, soldering safety, and connecting a MOSFET 'backwards'

I have quite a mixed bag for you this month. There are a couple of responses regarding problems playing some compact discs with some CD players, some helpful criticism from an expert concerning some of the soldering risks and other health topics we discussed recently, and a comment I half-expected about a recent project article where a circuit showed a power MOSFET which seemed to be connected the wrong way around. A little something for almost everyone, I think!

You may recall that in the December issue, I ran a letter from Mr Gerard Lawrence of Batemans Bay in NSW, regarding problems his customers had experienced trying to play *some* compact discs on their CD players. As the same discs would play normally on other players, it suggested that there might be a subtle compatibility problem — despite the tight industry specifications for both the discs and players.

It was all rather mysterious, especially as there seemed to be no consistent pattern which would suggest that a particular batch of discs were flawed, or on the other hand a particular brand or batch of CD players. Naturally enough Mr Lawrence wondered if other readers had struck the same problem, and/or could offer an explanation.

Well, so far I've had a couple of responses to this item, the first coming from Mr Fred Thorpe of Narrabeen in NSW. At least I *think* that's the right surname (your signature was a little hard to decipher, Fred). Here's what Mr Thorpe wrote, which adds some interesting further evidence to the discussion:

Congratulations for producing such a fine magazine. Its arrival on the news stand is the high point of my month.

I was glad to read Mr Gerard Lawrence's letter in your December Forum. As a purchaser of CDs I have experienced the same problems as Mr Lawrence, and I thought I was losing my marbles.

Since reading the article I questioned all the chaps in my section at work, and some of them have had the same experience — yet none of them has the same CD player.

In my case, I currently have two discs that will play on some CD players and not on others. They are 'The Three Tenors in Concert 1994' and 'The Richard Tauber CD'. The problems seem to be that the player can't read the data that tells it how many tracks are present, and whatever else it initially reads.

One of the most frustrating things is that if I take the cover off the player, it will play them every time. If I take the cover off and let it display the number of tracks and the playing time, then put the cover back on and press the play button, it will also play the CD right through. We have some other 80-odd CDs in the house that play perfectly.

Thanks for your comments, Mr Thorpe. From your description, it certainly seems that with the player and discs you've struck trouble with, at least, there's some sort of compatibility problem when the player initially tries to read the disc's 'table of contents' (TOC) information. It seems significant that if you can somehow get the player to read the information — in your case by temporarily removing the cover — then it will play the rest of the disc correctly, even if the cover is replaced.

Innermost tracks

From memory, the TOC information on a CD is carried on the innermost tracks, as the laser pickup 'plays' the disc from the inside outwards. So the fact that your player *will* read the TOC information on the problem discs, if its cover is removed, also suggests that the compatibility problem may involve the pickup's ability to play these innermost tracks.

I'm only guessing here, but perhaps this particular player is only *just* able to play tracks at the specified minimum diameter, with its cover on. And if certain discs have their TOC tracks on the *low* side of the nominal minimum diameter (but possibly still within the specified tolerance), this could conceivably cause the problem. Presumably removing the cover may be causing a slight shift in the player mechanism shape's, allowing the pickup to start playing at a slightly smaller diameter, and hence read the TOC information correctly.

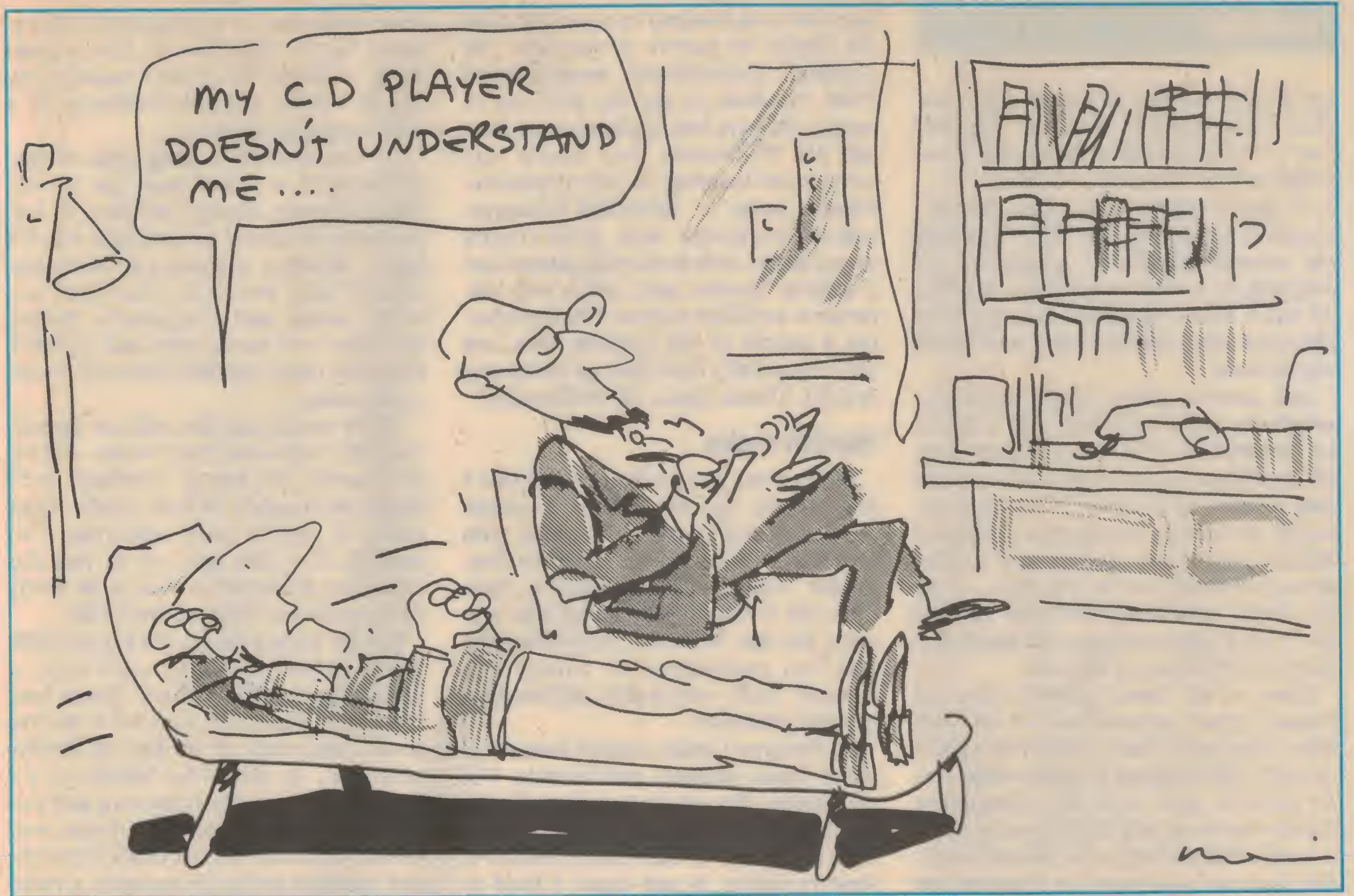
It seems a plausible theory to me, anyway, and I'll try to run it across one of the CD experts as soon as I can, to see whether it is a possible explanation.

In the meantime, though, let's look at our second current letter on the subject, which came from Mr John Williamson of Kingsley Electronics in Cheltenham, Victoria. Mr Williamson is apparently a service technician who has specialised in CD player repairs for some time, and his letter offers quite a lot of additional technical information:

I write regarding Mr Gerald Lawrence's query about why some new CD discs he sells won't play or mistrack on some customers' CD players, and are okay on other players with no apparent pattern to the problem.

Having serviced CD players since they first appeared in Australia, I have found the failure to play one of a collection of as-new discs is caused by a manufacturing parameter defect in the disc, combined with a player that is not operating at optimum performance. I.e., when both are 80-100%, the disc plays. But if the resultant of the two is too far down from 100%, then there is no play, intermittent play or play with some mistracking.

Often it is the first warning sign that the player performance has deteriorated below an acceptable level, either mechanically or electrically and its inability to cope with variations in a disc outside the normal expected limits. This can cover output, re-



flection, track pitch, eccentricity, warp — and with all discs, surface condition. Sometimes all that is required is cleaning of the laser lens and/or alignment of the focus and tracking adjustments to specifications. Tracking gain, for instance, can make the difference between playing the disc or not.

Checking the RF output (eye pattern) and tracking error waveforms at the RF IC against those from a known reference disc will show the variation from the ideal. On a used disc, surface condition, dust, dirt, scratches, and fingerprints also come into the equation, plus vibration, internal and external, affecting a 'poor disc' more than a good one.

Incidentally, the effect of scratches, etc. depends on the direction, length, depth, and which side they are on. It's the last one that breaks the error correction's back! A steady 'tic-tic' repeat on one spot is often a flake of clear plastic off the edge of the disc sticking to the read surface, or a pinpoint of black soot, or even dandruff — all easily removed.

Examples of past encounters with one-off titles or discs are as follows, and illustrate that they have been with us for some time and there is always a solution.

1. An early 80's experience was with the first model discman, which would show up as intermittent muting only on the 'Brothers-in-arms' disc. This usually indicated that the tracking voltage error output was below 65% of normal (the RFO waveform would appear normal). A new optical block was the only solution in each case.

2. Complete muting on track five only of a 12 track disc (display clock indicating progressing play). The control IC was changed for the same type with a different suffix number as used in a similar model, and it played okay.

3. There was mistracking for the first few seconds and loud mechanical resonance (800Hz vibration) from the disc/spindle/sled assembly. The player was very rugged and beautifully built, and very expensive. The disc was okay on cheaper players, etc. The disc was a German pressing of an 'Enja Watermark' disc (tape across the disc surface would dampen and correct). Another disc purchased played okay. The only difference noticed was that the track titles were printed rather than script and the batch number was different.

Note: When several discs display the same resonance (sounds the same as the party trick of running a wet finger lightly around the edge of a crystal wine glass), it can involve fitting damping to some parts and changing others to completely rid the unit of this complaint. It usually lasts for about 10 minutes of track time and can appear anywhere from the beginning to the outer edge of the disc.

4. A new player under warranty arrived from a distant suburb, with the complaint of 'chic chic chic - chic chic chic', a train-like sound on some tracks. No sample disc was with the unit, but an assurance that all the discs were new and clean. Only one track on one of the workshop test discs was found to make the described sound. The original quality and subsequent damage to this disc is so bad that normally I would not label a player as 'not good enough' to pass on the strength of this alone. But as the player was new and under warranty, and could not be faulted otherwise (keep the customer happy, etc.), I replaced the optical block whereupon it was perfectly 'clean' even on this track.

I phoned the customer to tell him it was ready and would he bring two or three of his discs as a final check. When he arrived, he said "there you are, perfect!", showing me the label side as he handed me the discs. "Actually, I'm more interested in the other side", I said as I turned one over, and there it was.

The 'steam train' was the owner's driv-

ers licence number, engraved across the disc! Fortunately he had only engraved four out of about 100 at that point. Some people always blame the machine!

5. A John Farnham disc, 'Then Again', wouldn't start play. The RFO was half the normal amplitude, gradually increasing to normal at track seven of the 14 track disc. I adjusted the player to play this disc. Another disc purchased was normal.

Just another factor which influences whether a player will cope with a disc is its 'generation'. The early players were all analogue, with many adjustments and dozens of discrete IC's. More recently, the change has been to automatic digital signal processing and digital servo processing all in one chip — i.e., the focus, tracking, sled and spindle servo gain adjustments are all automatic from the beginning of the disc.

Some of the latest players have no manual preset adjustments at all, and have electronic shock protection (ESP) as well. All designed to make them better able to cope with the information carrier we were told at first was perfect — and after records, they nearly were. But you can't use them as frisbees and still expect them to play, and I haven't mentioned varying disc thickness and 78-minute discs...

Thanks for your comments too, Mr Williamson. It certainly sounds from what you've found that there may well be *many* different causes of player/CD incompatibility, including things like within-tolerance variations in a variety of different disc and player parameters. I suppose this kind of thing is inevitable, when you consider the tiny tolerances involved in this technology. Presumably the next generation of higher-capacity video CDs and CD-ROMs will tend to produce even more problems along these lines, as the proposed 3.7MB capacity (compared with the present 600MB) involves even finer track and pit pitches...

I really liked that little aside in Mr Williamson's letter, about the bloke who had engraved his driver's licence number on the underside of his CDs, didn't you? No wonder he was getting a 'chic-chic-chic' sound — the error correction circuitry must have been working flat out to play the discs at all!

Incidentally like myself Mr Williamson has an interest in motion picture technology, and during a recent trip to the UK he was able to visit the projection box of the famous Odeon Cinema in Leicester Square, London. This very large box was featured in one of the classic books on movie projection, *The Complete Projectionist*, back around 1940. Needless to say the box and its equipment have been updated since then, and Mr Williamson very kindly sent some prints showing its very impressive current setup — including Cinemeccanica projectors with Sony digital sound heads, both horizontal platters and a vertical spooler unit, and a very impressive amplifier system. I'm reproducing a couple of the pictures here, and you'll hopefully find them as interesting as I did. Thanks again, Mr Williamson.

Health risks

Moving on, you no doubt recall that a few months ago we looked at various aspects of health risks associated with activities such as soldering. In the September issue I also published a letter from the former conductor of this column, Neville Williams, concerning the way his perception of colour had changed quite noticeably following a cataract operation.

At the time I made various comments about these matters, and because I'm well aware that my knowledge of biology and related subjects is much weaker than my grasp of electronics (which is steadily fading in any case), I tried to 'play safe' by making the comments as general and non-committal as possible. However it's always dangerous to offer comments or opinions in areas well away from your own limited expertise, and yet again I seem to have stuck my neck out too far — because a reader with much more knowledge in this area has written in to correct me concerning a number of the matters that were raised.

Now it's a little tricky to handle this one, because the reader concerned is a health professional and an academic, and like many such people is rather coy. He doesn't wish me to identify him, to quote from his letter either, so I'll have to proceed carefully and re-express the facts concerned in my own words (not easy when you're relatively ignorant in the field concerned!). You'll just have to take my word for it, that the original information comes from a person with excellent credentials in this area — although he says he doesn't consider himself at the leading edge. His letter was accompanied by a large set of photocopies from relevant textbooks and learned journals, though, to act as useful references.

Anyway, the first topic he raises again is the risk to health from the lead used in soldering. Basically our expert seems to agree that safety glasses are a good thing, and that the main risk is probably from the fumes — so presumably an exhaust fan or respirator is also a good thing, although he doesn't actually say so; he merely suggests soldering in a well ventilated location.

He continues by looking at the related question of whether lead can be absorbed directly through the skin, or not. Basically he seems to conclude that it's highly unlikely, and that a far more significant risk would be from lead and other metals and compounds finding their way into our mouths and digestive tracts, by direct transfer from our hands, while eating.

As he points out, this risk can be substantially eliminated (my words, not his of course!) by simply washing one's hands thoroughly before meals, especially if you've been soldering. Fair enough; I'm sure most of us had this procedure drummed into us quite firmly by our parents, when we were kids.

But the topic wherein our expert really draws attention to my own lack of knowledge (and that of my former boss Neville Williams too, I guess) is the one about 'yellowing of the lens of the eye with age', as raised by Neville in the September issue. He points out that this phenomenon has actually been well known for some time in medical circles, and includes in his photocopies a reference in a 1984 textbook *Clinical Neurology of Ageing*, by Martin L. Albert MD (Oxford University Press), to a paper published by researchers Said and Weale, in 1959.

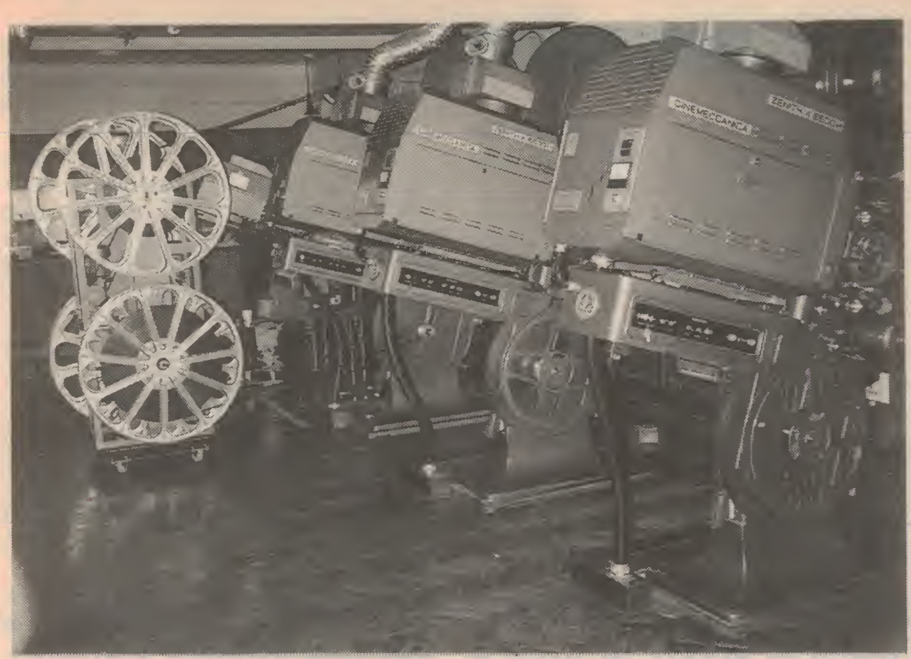
So it appears that Neville and I were both in error, in suggesting that this phenomenon hadn't attracted much interest or discussion. Even though we electronics types didn't realise it, it looks as if medicos and health scientists have been looking into the subject for many years...

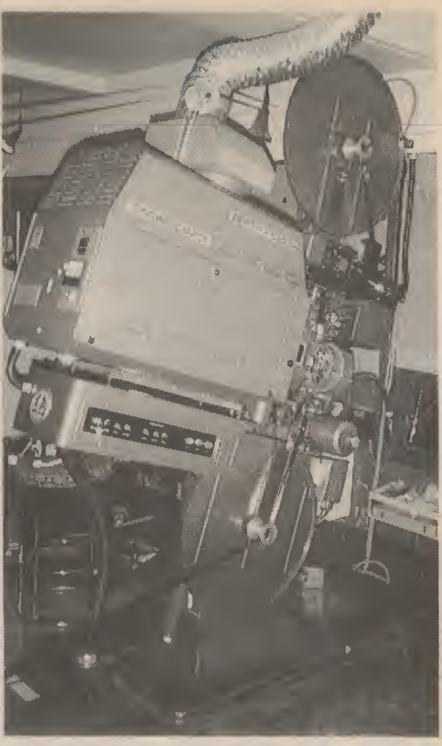
Just the opposite!

Finally, it seems that my own comments about ageing and skin colour changes were well away from the mark. Far from our skin getting darker and *less* transparent as we age, our expert points out that in general the reverse is the case. He provides a copy taken from a textbook *Ageing and the Skin*, by A.K. Balin MD, PhD and A.M. Kligman MD, PhD (Raven Press, 1989), which in fact summarises the situation thus:

The degree of pigmentation decreases with aging. This results from both a loss of melanocytes with increasing age and decreased metabolic activity of these cells. The decrease amounts to between 10% and 20% per decade and is mainly found in non sun-exposed skin.

So there you are. I guess I was making





Two of the pictures taken inside the projection box of the Odeon Cinema in Leicester Square, London, sent in by reader John Williamson. The projectors are fitted with Sony digital sound heads, mounted above the main projector head.

my comments from a position of almost complete ignorance, based purely on layman's observation of a small number of elderly relatives and friends. Now I recall, some of these people (now deceased, sadly) had either spent much of their lives in the sun, or had been quite ill and on heavy medication for years. Perhaps my impressions had been 'led astray' as a result...

Anyway, my apologies for these mistakes, caused largely by commenting on areas of knowledge where I'm basically just a layman. I'll try to watch it in future!

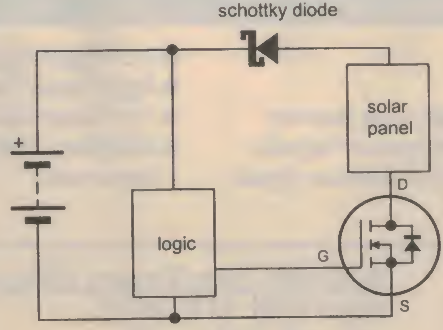
My thanks to our rather shy expert, then, for setting the record straight. By the way, he also included copies of articles and papers on the subject of human colour vision — including the classic article by Dr Edwin Land, in the May 1959 issue of *Scientific American*. As our expert points out, there's still a great deal we have to learn, about exactly how we perceive colours.

That power FET...

Changing the subject again, you may recall that in the November 1994 issue, we ran the first of two articles by Peter Phillips and Conrad Marder, describing an Intelligent Battery Charger. In that particular article there was a diagram labelled Fig.3, showing what was described as the basic circuit configuration used in many solar panel current regulators, using a power MOSFET as the current pass element. (I'm reproducing the diagram here again, to save you having to refer back to it.) The text explained that a basic problem with this type of circuit was that current was always flowing, due to the MOSFET's internal protective diode.

I remember that when I was checking the article before publishing it, I tripped up on this diagram and explanation myself. It didn't seem plausible that anyone would even try using this exact circuit configuration, because the MOSFET was clearly being used 'back to front' and that was obviously why its protection diode was conducting all the time.

Puzzled, I rang Peter Phillips and asked him to check with Conrad Marder and Oatley Electronics, in case someone had made a silly mistake. The next day Peter rang back to confirm that no, a mistake hadn't been made; crazy though it seemed, many of the existing circuits for



This was the diagram in question, labelled Fig.3 in the November article.

solar panel regulators appeared to use this very configuration, with the MOSFET connected the wrong way around.

I confess I still wasn't entirely convinced, but having been assured that a mistake hadn't been made, I decided to run the article as it stood. I fully expected, though, that at least some readers would find the circuit as weird as I had, and would write in to query us about it.

Well, at least one reader had the same reaction, and has written in accordingly. The reader concerned is Mr Garry Boyce of Crafers on South Australia, who has contributed to this column on previous occasions. Here's what he has to say:

Just a quick comment on the Intelligent Solar Battery Charger design in November EA.

The discussion of internal diodes in FETs had me a little worried, as I work on commercial systems with just such negative rail switching. A check with the data book did indeed reveal an internal diode, which the International Rectifier manual states is an inbuilt bonus with a current rating equivalent to the transistor. How could the circuit switch off at all, then?

It took a few minutes to realise that the FET in Fig.3 of the article seems to be connected wrongly. Surely the main current should normally flow from drain to source? Turn the FET around, and all of the 'problems' would disappear. Am I overlooking something?

While I am about it, maybe I could offer a comment on the TETIA saga in Forum. I am ever so grateful that my parents let

NOTES AND ERRATA

Versatile solid state Audio Recorder (Feb 1995): The parts list on page 62 has an omission: the three SIL resistor packs RP1-3. These consist of eight 47k resistors, with a common connection — giving nine pins in all.

Low cost 1GHz counter (April 1993): When fitted with the High-Resolution Modification of March 1994, the kHz LED may still glow significantly when the MHz ranges are selected.

This is due to the output voltage from U2 on the modification board being lower than 5V, causing incomplete switching of the LED driver transistor (Q5).

This can be remedied by transferring the connections for the rotors of SW1b and SW1c to switch SW2, instead of to the terminals to the mod PCB. The wire that connects to SW1b goes to the unused contact, while that for SW1c goes to the contact which connects to pin 1 of U2 on the mod PCB. ❖

FORUM

me 'stuff up' a few electronic goodies, when I was young. I would never have made it into electronics otherwise.

Why are the techs worried about people having a go at fixing their own stuff anyway? If they make it worse, they will have to pay to get it fixed, giving the service people more work.

One of the main benefits of mags like EA is to share information. Where would the scientific community in general be if we all closed shop for individual commercial gain?

Hmmm, thanks for those comments, Garry. I'm inclined to think that your suggested solution is indeed the right one, as far as the configuration of Fig.3 is concerned. Even though it involves reversing the 'drain' and 'source' connections of the MOSFET, the channel of these devices is usually quite symmetrical in itself, and devices without a protection diode can usually be connected in circuit either way around. Since the controlling action of the gate is determined by its potential relative to the channel as a whole, we should therefore be able to use the device whichever way around (in terms of nominal 'drain' and 'source' connections) we wish — giving the opportunity to select the connections which *don't* result in shunting by the protective diode, as you suggest.

So I don't think you've missed anything, Garry. On the contrary, I think you've spotted the error in Fig.3 (which I confess I missed), and provided a logical explanation as to why the regulators which use this configuration really do work, after all!

I'm not proposing to comment further on your other remarks, about the TETIA controversy. Not that I disagree with anything you say, which makes good sense; however I think I've made my own position fairly clear, and it's probably better that those of us with a viewpoint different from that of TETIA simply agree to differ, and let the matter rest.

And that's about all we have space for, this month. I was going to take a look at the ongoing controversy about Australia's mains voltage, and whether it should be changed to 230V, but that will have to wait until next month. ❖

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READER INFO NO. 10

THE SERVICEMAN

"Oh — you might like to fix the TV, if you get bored!"

One of my stories this month comes from our old friend Les Kemsley, who had to exercise considerable ingenuity when he tried to fix the Sanyo CTV in a friend's holiday cottage — with nothing more than a multimeter. There's also a story from my own bench, about an NEC that developed a mysterious penchant for blowing power supply chopper chips...

Contributors to the Serviceman column have always been introduced by their initials only, for reasons that are lost in the dim and distant past. Recently, in response to suggestions from readers, other columns in this magazine have dropped the practice and begun using their contributor's full names. So now we've decided to do the same here.

Most of my contributors deserve full recognition for the skill with which they go about the work which provides the subject of the stories. Giving their initials only might once have had a purpose, but no longer. I know the full names of contributors, so why shouldn't readers also?

So unless you tell me otherwise when you send in a contribution, I will use your full name, town and state in the introduction — as in the followng yarn.

This one's a contribution from our friend Les Kemsley, the former L.K., of Daintree in far north Queensland. It's another of his 'Holiday' yarns and as usual, it's told with his characteristic good humour. Let's hear what he has to say:

The man was a friend of mine, or at least he said he was a friend of mine. If he wasn't then, he is now — because he gave Mrs K and I the use of his beach house for a few days, during our recent holiday...

Then again, maybe he wasn't a friend, because as he handed over the keys, he mentioned that there was an "...aged Sanyo CTV in the lounge room, which had some minor fault, and I might care to have a look at it, if boredom became a problem". I don't know why he thought I would want to swop one problem for another!

The thought of the dreadful distortions that might be displayed by a TV that had been subject to a corrosive sea breeze for years kept me from switching the thing on for a couple of days. However, I eventually summoned the courage to do so, with the thought that the set may well be too old and too far gone to bother about.

My eyes didn't like what they saw, emanating from the large screen CTP8601 when it came to life. The picture was overbright, with visible retrace lines and an overall pale shade of green being the only colour present. If that was not enough to scare me away, it also had a constant flicker at about 15Hz, depending on picture content, and a dark area right down the left hand side of the screen!

The set did have two things in its favour, though. The cabinet was unmarked, and the sound was fine!

I almost gave up there and then, but he was 'a friend of mine', so it seemed that I owed him a few minutes of probing, if only for old time's sake.

The appearance of the chassis when the back was removed allayed all my pre-conceived ideas. It was virtually dust free, corrosion free and appeared never to have undergone a repair. (Later I learned that the set had belonged to my host's father. Upon the parent's recent death, none of the family had room for such a large piece of furniture, so he had exiled it to this holiday home.)

I decided to tackle the over-brightness first, and see what gyrations remained afterwards. The tube screen voltages were the most likely culprit, but unfortunately they checked OK — as did the first grids.

An oscilloscope would have been handy at this point, to examine the blanking pulses and cathode voltages; but when on holidays, one can't carry everything. All I had was a multimeter, which does not always give an accurate answer when faults are present. However, in this case the reading came to around 50V, which was too low under any circumstances.

Next, I wanted to read the rail voltage feeding the driver transistors. The easiest spot to find it was the hot end of their collector load resistors. It was while locating them that a faint point of light angled to my eye from the main board. Not wishing to be side-tracked, I mentally noted it for later investigation.

The particular rail would need to have been in the 200V region, but measured only about 70V. I say 'about' because it was not constant, but rather drifting slowly around that figure. Nothing seemed to be stressed in the area, so a faulty rectifier diode and its associated capacitor came under suspicion.

Before working my way back there, I had another look for that light source. I experienced difficulty in finding it a second time, but once located, I realised why. It was only visible from one precise direction, and the origin turned out to be at the base of an electrolytic near the

line transformer! This was too much of a coincidence to ignore, and a check using the ohms range of my meter revealed a direct link from the load resistors to that spot.

I very carefully removed the capacitor, but I was unable to prevent the positive leg from disintegrating. The board itself was slightly stained but otherwise unmarked, with both solder joints first class. I can offer no further information to those readers who enjoy pondering these enigmas to finality.

This left me with a problem. Where would I find a 10uF/300V electrolytic, without driving to the city and back?

Now there resided, on top of the refrigerator in the kitchen, a working mantel radio from the valve era. (This house was a mini electronic museum!) It was ancient enough, I reasoned, to have had its filter electros replaced at some stage. Anyhow, it was worth a look. Fortunately, wired in under the chassis were two relatively new 33uF/350V types — near enough for me, under the circumstances. I snipped one out and wired it into the Sanyo. It was too large to fit in the available space on the board, so I strapped it firmly to the edge of the main board and connected it into circuit with a couple of fly leads. (The radio could always be restored if need be, when we returned the keys at the end of our stay.)

When I next switched the TV on, it brought up a picture without blemish. I was as surprised as I was relieved, and can only tell the story the way it happened. Looking back at the many symptoms, that single faulty capacitor could account for all but one of them. There seemed to be no explanation for the loss of colour. I have subsequently scanned the circuit for this model and cannot establish an association between this power line and the chroma section.

So once more the customer was right — it was only a 'minor fault'. (Aren't most of them, in retrospect?) What is more, if I had been a bit less technical and a bit sharper of eye, the colossus could have been repaired without even resorting to the use of the multimeter.

Thanks for that story, Les. It seems that your recent holiday was well and truly paid for by the incidental jobs you picked up along the way! As for the big Sanyo, the fault you describe is not all that rare. I have struck it several times, but have never needed to cannibalise an old radio to complete the repair!

I can understand your puzzlement about the loss of colour, but with the benefit of a bit of theory (and a copy of the circuit diagram), it's possible to explain where the colour went.

The luminance content of the picture is delivered to the output transistors at their emitters. This means that the gain of the stages is not so important. The picture will still appear on screen, albeit at an unusual contrast level.

By contrast, the chroma content is injected at the transistor bases, and the current gain of each transistor is heavily dependant on the collector voltage. In Les's story, the collector voltage was much lower than it should have been and thus the chroma gain was way below normal.

Les also mentioned a 'pale shade of green' as the only colour on screen. If this was an overall colour, it suggests that the white balance was slightly

off. If the pale shade of green was really part of the picture, it's likely that the green output stage was not quite as susceptible to the low collector voltage as the other two.

Whatever, the failure of a single electrolytic can be blamed for a dramatic alteration of operating conditions in the video output stages, and the consequent grotesque changes on screen. Incidentally, the rogue capacitor is C473 in the accompanying diagram.

The real point of interest in this story, for me, is Les' ingenuity in finding a replacement part in the most unlikely place. I mean, on top of the fridge — who would ever think of looking there?

Thanks, Les. More holiday stories, please.

Another problem NEC

Now, for a long tale of misery from my own bench.

Have you ever felt you would like to strangle John Logie Baird? If you remember, he invented television. If he had kept his ideas to himself, we would not now be beset with all the problems associated with keeping customers happy...

That touch of anti-social philosophy arose from my recent experiences with an NEC colour TV, a model N-4830 to be exact. I know I've said a few rude words about NEC sets in recent columns, and I've acknowledged that the problems were not of that company's making. Similarly, the problems encountered with this set could honestly be traced back to design or production faults which seem to be out of the control of NEC (or any other company who chose this manufacturer to badge sets for them).

It all began when the owner brought the set in and said that it wouldn't switch on. As is usual in this sort of situation, he blamed the power switch. His request was quite simple: would I please fit a new switch? I offered to do that if he insisted, but I assured him that the trouble was more likely to be somewhat deeper inside the set than the switch.

Eventually, it was agreed that I would investigate the problem and give him a report on what was wrong and the likely cost of repairs. His problem was that the set was only a month or two out of warranty and if the repair was going to be expensive, he would go gunning for NEC. (I understand the owner is a solicitor, so I wouldn't like NEC's chances if they crossed him!) However, he was quite reasonable about the matter and agreed that if the cost was going to be moderate, he would meet it and write it all off to experience...

There's a lesson in the foregoing comments for all aspiring TV servicemen. The ability to placate irate customers and smooth the path between customer and manufacturer is probably more important that being a whizz-bang technician.

I don't know if I am particularly talented in this direction, but in 20 years I have never had to advertise — I've always had more than enough 'word of mouth' custom. Even now, in semi-retirement, old customers still beg me to sort out their problems. You won't get rich by spending time settling arguments for your customers, but you do earn a lot of goodwill that keeps them coming back year after year.

Anyway, back to the N-4830. Once I got it on the bench with the back off, I soon learned that the AC fuse was blown. This could have been caused by

one of the bridge diodes going short, or by a short-circuited 'chopper chip'. (Don't you like that? Sounds better than 'chopper transistor', doesn't it...)

Finding the bridge diodes was not easy, either on the board or in the manual. It was much easier to test the chopper, since the manual gives a full internal schematic and shows pins 10 and 8 to be the significant points — pin 10 connecting to the collector of the internal power transistor, and pin 8 to its emitter.

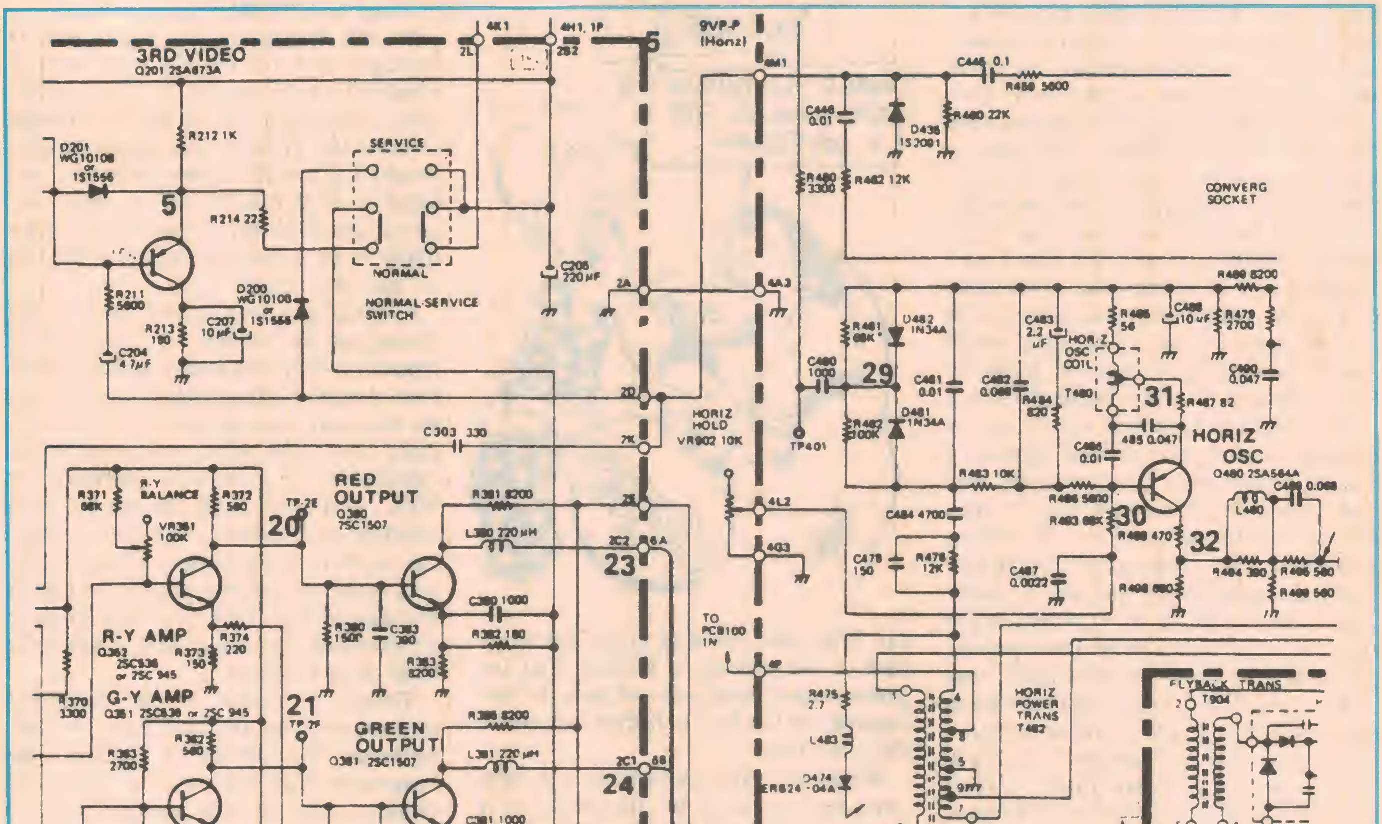
In this case, pins 10 to 8 showed zero ohms between them, so I gave up worrying about the bridge and concentrated on replacing the chip, an STK73410/II. And at this point I recalled a modification note issued by NEC to cover occasions when this chip has to be replaced.

It seems that various changes had been found necessary during the course of a fairly long production run, so the mod notes list the changes by chassis type and serial number. Low serials need substantial changes, while the higher numbers have already had most done in the factory.

It took no time to determine that this set was one of the lower serials, so it looked as though I was going to have to do the full range of mods. On reflection, this seemed a bit strange, since the set was not long out of warranty and should logically have been among the high numbers. Oh well! it might have been lost in some warehouse along the distribution chain — the important thing was that it was a near-new set and had to be repaired.

My first task was to identify the parts that needed to be modified. The list covers four resistors, one diode and five capacitors. The actions required include changing values, deleting, and relocating to the opposite side of the PCB. It's quite a long routine and not one to be undertaken lightly.

The resistors are R802, R803, R805 and R820. It was when I came to check these items that I began to doubt the reliability of the serial numbering system used in these sets. R802 and R820 were spot on, while R803 was 150k, the same as the required new value for this



The video output stage of Les Kemsley's Sanyo. C473, visible at lower right, is the only bypass capacitor on the 200V supply to the video output transistors. When it went open circuit, the transistors were robbed of their full supply rail and had to do their best with a very spiky supply direct from the line output transformer.

resistor. It looked as though some of the mods had already been done.

R805 was in a different class. It was open circuit, no doubt as a result of the catastrophe that had killed the chopper chip. Of the various other mods, all appeared to have been done. D805 and C809 were both deleted and the other capacitors were all of the required value and in their correct places!

So, serial numbers notwithstanding, this set had already been through the modification mill. There was just one other item to be checked. It's not shown on the mod sheets, and now I can't find my reference, but T802 should be changed if it's 'a red one'! The correct type is 'a blue one'.

I searched the board for a red or blue transformer, but couldn't find a thing. I found T802, but it was a metallic gray. T803 was a 'yellow one', and there were various other small components of many hues, but no red or blue transformer.

At about this time the owner rang to find out what was going on. I gave him an outline of my findings so far, then mentioned the puzzle of the transformer. His only comment was "Leave that to me!"

Next day I had a call from the local NEC distributor, asking please what was going on? I gave him a quick rundown on the problem, with particular reference to the confusion over the transformer. He offered to solve that immediately, by getting a replacement under some kind of arrangement he had with certain people. In the event, it was a couple of weeks before the part arrived and I was able to complete the job.

In the meantime, I had replaced the STK73410/II and the open circuited R805. I also found R808 open circuit, so that got the treatment too. The set fired up and gave a picture every bit as good as I would have expected. I advised the customer that he could pick up the set and that I would fit the new transformer as soon as it was available. However, he preferred to wait so the set stayed in the workshop, playing away quite happily for the next two weeks.

In due course the new transformer arrived and appeared to be identical to the old one. The metallic gray cover on the old unit turned out to be a mu-metal magnetic shield, which when removed, revealed a common type of low voltage transformer with, of all things, a 'blue' tape binding wrapped around its core.

So it seems that I came a cropper over that one. Nothing in the mod notes suggested that the 'blue' and 'red' identification could be found UNDER the magnetic shield, and I didn't think to look. The original transformer was the right type from the beginning, and all the hassles over a replacement were un- necessary.

But how much easier all round would it have been if the specifications had been by part number. I would probably have been forced to lift the transformer to find the number and there would have been none of this confusion!

Anyway, the set eventually went home and by all reports performed uneventfully for just on two weeks. Then one morning I had a phone call, reporting that the previous night the set had gone 'phutt!' and emitted a puff of acrid smoke. Noises like that and puffs of smoke usually don't bode well for the health of a TV, so I advised the owner to get it back to me as soon as possible.

With the set on the bench and the back removed, the source of the smoke was clear to see. There had been an arc between the track to pin 10 on IC801 and an adjacent earthy track. The hot track carried current to the internal chopper transistor, so there had been ample joules available to create the smoke. In fact, it had also taken out five or six millimetres of the copper track itself.

The missing track was the first thing to be replaced, and that offered no particular problems. Needless to say that was not the only trouble and the main fuse was the next to get attention. This was open circuit, most likely because the chopper chip was shorted! So in effect, I was right back to where I had begun, a month or so earlier.

After fitting a new chopper, the power supply was up and running, but there was no immediate response from the set. At first I thought that everything was dead, but a moment or so later I realised that the tube heater was alight and that there was EHT present at the screen. But there was no sign of a signal and no sound — not even a trace of hiss.

I began my search for the lost signals with an examination of the voltages around the tuner. The usual 12V B+ was there, but there was no 30V tuning voltage and the voltages on the bandswitching terminals made no sense at all. So, whatever the trouble was, it was robbing the tuner of any sensible control.

In this set, virtually all the control and display functions are concentrated in a single 42-pin microprocessor, on a small plug-in board mounted near the centre of the main PCB.

The chip is a M34300-230SP and includes everything that opens and shuts. It decodes the front panel and/or remote control key presses and provides the relevant control voltages; it includes the on-screen character generator; it selects the channels and provides the channel memory; and it also provides switching for the audio/visual input sockets. In fact, it's a very busy little chip!

Because of its location, standing up at right angles on the main PCB, it wasn't practical to take any voltage measurements at the chip itself. All I could do was to ensure that there was a 5V rail present at the base socket, then remove the board and check for continuity along the various tracks.

Pulling the board immediately answered a few of the questions regarding this chassis, since the screen lit up

with strong snow and the sound came good with a crashing roar. Needless to say I could not control either brightness or volume, but the display confirmed that the power supply, horizontal and vertical stages, and the audio output were all OK and should respond normally, given a proper signal.

Apart from the microprocessor chip, the plug-in board contained very few components. There were a few diodes, a handful of small transistors and a second, small eight-pin IC. All of the diodes and transistors checked OK so the fault, if it was on this board, had to be in one of the two ICs. And for my money, it had to be the micro.

Unfortunately, there is no way you can test these complicated multi-pin ICs. The only practical course of action is to replace the item and on occasions, this can be a quite expensive experiment. In this case, it wasn't too bad since a replacement chip cost just under $20. If my guess was wrong, the part could go into stock without too much strain on the bank account.

However, in this case my guess was right because replacing the chip brought everything back to normal. I had to retune all the local channels, since the memory had gone with the dud chip. Otherwise, everything seemed to be normal — but for one thing.

All of the front panel switches worked properly, except for the volume control buttons. The sound level was quite low, and nothing I could do would raise it.

At this point I rang the owner and asked him to bring in the remote control. This should indicate to me whether the fault lay in the new chip or in some part of the circuit between the front panel switches and the chip input.

In due course I was able to prove that the chip was OK, since the remote unit had full control over the volume. This left only the switches and the PCB tracks across to the microprocessor sub-board.

To make a long story shorter, it proved to be the switches themselves. The two sub-miniature button switches were mounted one above the other on a small metal bracket. They were quite independent of each other, yet for some reason both had gone open circuit in the same way, at the same time. Identical switch types were used for channel selection, tuning, colour and brightness controls, yet they continued to work perfectly.

I advised the owner of what I had found and suggested that it would take a week or so to get a replacement assembly from NEC. He wouldn't hear of it and insisted that neither he nor his family ever used the panel switches. So long as the remote control worked on all functions, he was quite happy.

So there it is. I have no idea why the power supply flashed over as it did, and in the process caused a lot of other damage. The only possible suggestion I can offer is that a small insect got in through the cabinet ventilation slots and was disintegrated for its trouble. I've seen a spider make a mess of a picture tube base board and ruin the tube in the process, so it could explain why the NEC tried to spontaneously combust.

The only other thing that remains unexplained is why the set appeared to have undergone all required modifications, yet acquired a low serial number that suggested it should have been in virgin condition. Stranger things have happened in the world of domestic electronics, but it doesn't make the serviceman's lot any easier.

That's all for this month. There are more contributors lined up for next month, plus who knows what else from my own bench. See you then? ❖

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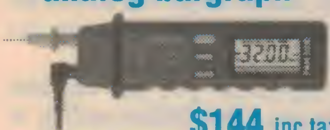

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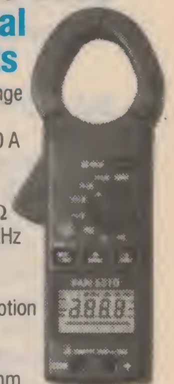

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Construction Project:

MAINS APPLIANCE REMOTE CONTROLLER - 1

This project combines a proven 240V phase-controlled triac circuit and a UHF single-channel remote control system to give a remote control unit for mains appliances. It has five power control settings, a timer, a LED display and a small battery powered transmitter. Use it to control a ceiling fan, a heater, a light or any mains appliance that can be controlled by a triac. This month we examine the circuit details; next month we explain how to build it.

by JEFF MONEGAL and PETER PHILLIPS

Although originally intended for remote speed control of a ceiling fan, this project can be used to control a whole range of mains appliances. It's conceptually simple, although it was much easier to think up the idea that to implement it...

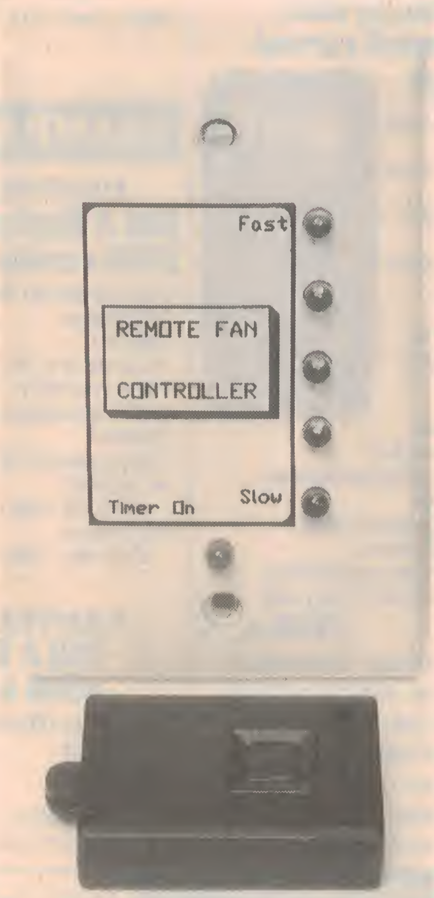
Basically, the circuit consists of a phase-controlled triac, an optically-coupled resistance network, a pre-built 304MHz UHF receiver module and control logic which also includes a timer. As well, there's a handheld UHF transmitter and, as the photos show, a number of LEDs to indicate the control setting.

The controller is connected in series with the appliance, and a power setting is selected by pushing the transmitter button the required number of times. Each setting selects a resistor, whose value determines the conduction angle of the triac, and therefore how much power the load receives.

Power to the appliance can be turned off via the transmitter in one of three ways, depending on the setting of a link. The first way is independent of the link setting and is by selecting the 'sixth' position of the controller, which effectively sets the phase control resistance to infinity (open-circuit).

If you install link A, pressing the transmitter key for about one second will cause a timer to start, indicated with a green LED. After about an hour, the timer will turn off the appliance.

If link B is fitted instead of link A, the appliance can be turned off by holding the transmitter key down for a second or so. Another one second press of the transmitter key will switch on the appliance, but to the original control setting. This avoids pressing the transmitter key a number of times to get back to the original setting, as is the case if you



turn the appliance off by selecting the sixth setting.

So what type of appliances can you use with this device? The maximum load current is determined by the triac ratings and the size of the heatsink, so the limitation is with the triac. The specified triac can pass a current up to 15A, which, by the way, is only possible if a suitable heatsink is used.

Without a heatsink, the maximum load is around 200W. A small heatsink (say four times the area of the triac tab) will increase this to 500W or so. For a higher load power, attach a heatsink with a surface area of around 2500 square millimetres or more.

However, don't forget the tab of the triac is at mains potential — so the heatsink will be as well!

Typical appliances you can use with this project are a fan (either ceiling or floor), a heater, incandescent lights, a small stove (imagine — a remote controlled stove!), or any resistive type mains appliance.

There is no benefit using this device with a motor, other than a shaded pole motor as in a fan, as the speed of most AC motors is determined by the frequency of the supply, not the voltage. However, some universal motors might work with the controller.

We don't recommend using the controller with a fan heater, as the shaded pole motor typically used in these heaters will slow down on the lower power settings. This might reduce the air flow to a level that's insufficient to keep the heating element from glowing, possibly causing the over-temperature cutout in the heater to operate.

The controller is virtually fail safe, as the worst that can happen is the appliance runs at full power if the triac becomes a short-circuit. And in case you're wondering how to fit the controller in a circuit where the neutral is not accessible: you don't need to.

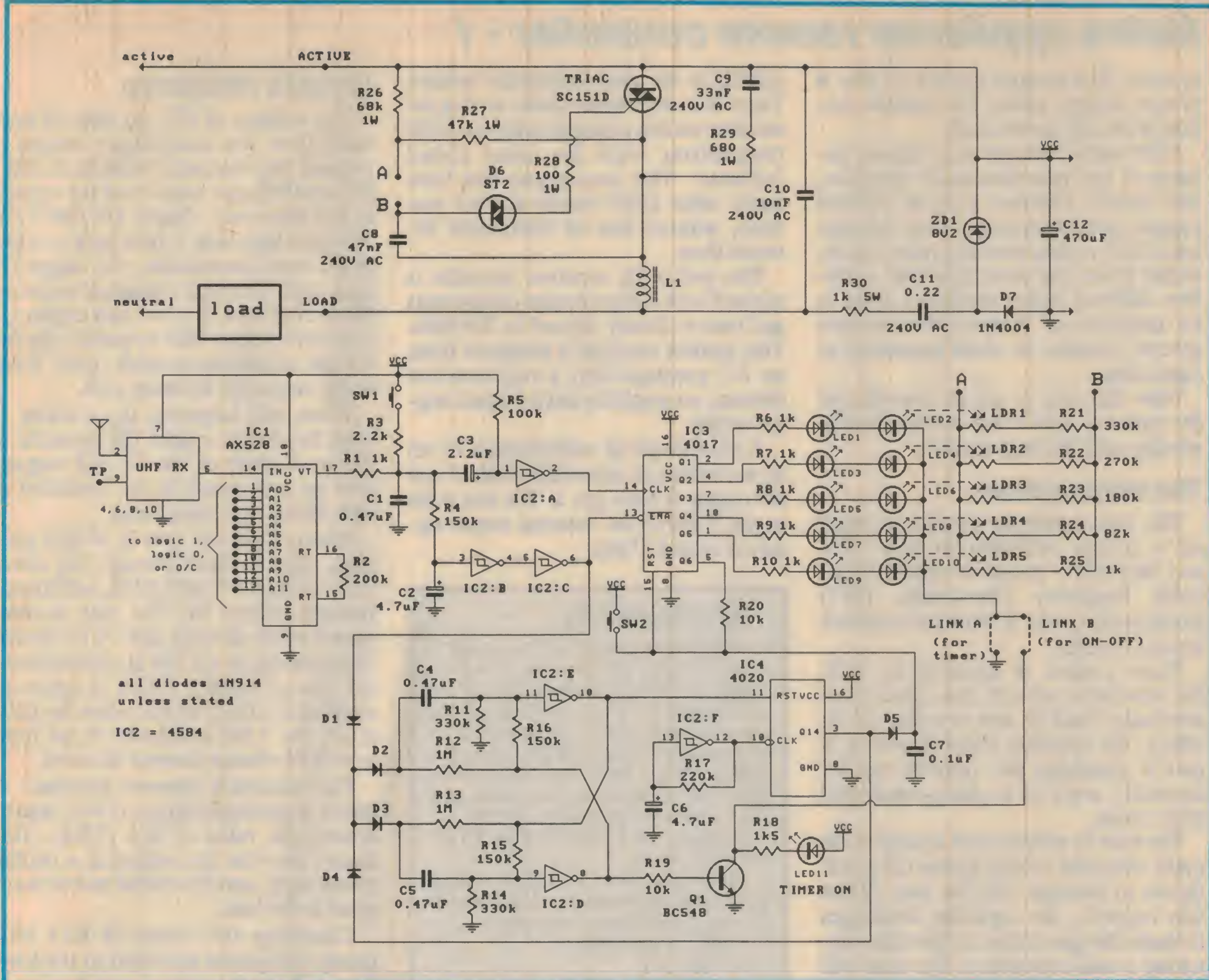


Fig.1: The variable resistance for the phase-controlled triac section is the network comprising the LCR's and resistors R21 - 25, controlled by IC3. Note that the earth symbols indicate the negative supply rail, and must not be connected to earth.

Now for a brief look at the development of the circuit.

Background

Because the device was originally intended to be a speed controller for a fan, it made sense to use an existing triac controller design. The fan controller circuit described in *EA* July 1991 was ideal, except it didn't lend itself easily to remote control.

The aim was to have five power control settings, as this is the usual number with a ceiling fan. This is easily achieved by selecting one of five fixed value resistors, in place of the usual potentiometer. It remains to solve how to do this selection with a remote control system.

Bi-lateral CMOS switches could not be used to select each resistor, because of the 30 volts or more required to trigger the triac via breakdown of the trigger diac. Transistors were not suitable either, as they only conduct in one direction, while the trigger circuit produces both positive and negative pulses.

Another problem was how to derive power for the control section of the circuit. Remember this circuit had to be designed on the assumption that a neutral may not always be available. This is typically the case with a ceiling fan, where the neutral connects to the fan only, and not the wall mounted controller.

The power supply problem was solved by using the voltage drop across the triac, but this technique meant the load current to the control circuit had to be kept to an absolute minimum.

For this reason, opto-couplers could not be used to select resistors in the phase control circuit, as the LED in an optocoupler requires at least 12mA of current to get reliable switching.

By experiment, we found that the control circuit current was limited to 6mA. More than this caused the supply voltage to drop below four volts. Increasing the supply voltage to allow more current made the 1k series resistor (R30) too hot. As the unit might be mounted inside a wall, any heat generation had to be kept as low as possible.

The solution was to make our own optocouplers by using high brightness LEDs and high quality LDRs, optically coupled by supporting them in heatshrink tubing. This arrangement would conduct equally well in both directions, could handle the voltage required and needed only one or two milliamps of LED current.

The rest of the circuit is the remote control transmitter and receiver, and the control logic operated by the remote

system. The remote system is also a proven design, where the receiver section is already constructed.

UHF radio control was chosen because it has non-directional operation, and doesn't interfere with an infrared remote control system. Also, because each UHF remote control system can be coded (there are more than half a million different codes available), there is no problem of interaction between several systems in close proximity to each other.

Now that you've got an overview of the project, here's the circuit details, starting with the triac section.

The triac section

The triac controller section is based on a design published in July 1991 and includes a phase-controlled triac, radio frequency interference (RFI) suppression, and a snubber network around the triac.

Phase control is achieved by R26, the resistance network that connects to terminals A and B, and capacitor C8. In effect, the resistive network across A and B simulates the variable resistor normally used in a phase-controlled triac circuit.

The triac is turned on at a point in the cycle when the voltage across C8 is sufficient to forward bias the diac. When this happens, the capacitor discharges through the gate circuit of the triac, triggering it into conduction. The triac will turn off when the current flowing through it falls to zero, as it does twice every AC cycle.

The snubber network is formed by C9 and R29 and helps prevent false triggering due to spikes on the supply. RFI suppression is provided by C10 and L1, a small inductor on a toroid. Note that all capacitors in the triac section are 250V AC rated.

Remote control system

The UHF remote system is a standard single-channel 304MHz transmitter and receiver.

The circuit of the transmitter is not included here, as the type of transmitter supplied in the kit may vary. In all cases, full constructional details of the transmitter will be provided in the kit. Suffice it to say that pressing the transmitter button causes a UHF transmission of a coded signal at 304MHz.

As in previous designs, this UHF remote control system is based around a trinary encoder IC type AX526 in the transmitter, and a trinary decoder type AX528 in the receiver/decoder section. These ICs are programmable so that the receiver section responds only to a UHF transmitter with the same coded 'address'. This means you can have many other UHF remote control systems, without fear of interaction between them.

The pre-built receiver module is stocked with surface mount components and comes already aligned to 304MHz. This module contains a bandpass filter, an RF preamplifier, a regenerative detector, an amplifier and a Schmitt trigger output.

A short length of wire (250mm or so) as an antenna is connected to pin 2 and the output is from pin 5. The test point at pin 9 shows the detected output signal, at around 4Vp-p.

The output of the receiver module is the original digital data sent by the transmitter and is applied in serial form to the input of trinary decoder IC1, type AX528.

The address inputs of this IC should match those of the encoder in the transmitter, and the value of R2 (timing resistor) should also be equal to its equivalent in the transmitter. In practice, these two resistors can have a spread of two to one. For instance a 220k resistor in the transmitter and a 330k resistor in the receiver will work.

When IC1 receives a valid signal from the receiver, pin 17 goes high. When the button is released, pin 17 goes back to a low, and this negative-going signal is coupled through C3 to pin 1 of IC2a. Its output (pin 2) goes high, which clocks the Johnson counter of IC3.

Variable resistance

The outputs of IC3 go high in turn, each time the transmitter button is pressed and released. Pushbutton SW1 (if installed) also increments the counter in the same way. Output Q1 (pin 2) of IC3 goes high first. It falls back to a low at the next transmission, and output Q2 goes high. The next transmission causes Q2 to drop back to a low, and output Q3 to become high. This sequence repeats for the remaining outputs, until eventually output Q6 becomes high.

When this happens, the counter is reset to zero, as output Q6 connects to the reset input of the IC. All outputs now go low, which is the condition to turn off the triac completely.

When output Q1 (pin 2) of IC3 goes high, current flows through the series connected LED1 and LED2, and current limiting resistor R6. The path is completed either through link A to ground (timer mode) or via link B and transistor Q1 (on-off mode). LED2 is optically coupled to LDR1, so that when the LED is on, the LDR resistance drops from over 30M ohms to around 2k ohms.

The resistance between terminals A and B accordingly drops, in this case to around the value of R21 (330k). This causes the triac to conduct at a certain phase angle, and controlled power is applied to the load.

Changing the value of R21 will change the power delivered to the load. So in effect, the optical switches made by close-coupling the LEDs and LDRs connect resistors R21 to R25 across terminals A and B. Because the outputs of IC3 are high one at a time, the resistance across A and B is either very high (all outputs off), or equal to the sum of the on-resistance of the selected LDR (about 2k) and its series resistance.

Resistors R21 to R25 determine the five control levels and can be any value between about 400k and 1k. The values used in the prototype are shown on the circuit diagram, but these can be varied to suit a particular load. The higher the value the less the power to the load.

On-off section

A *short* press of the transmitter pushbutton will give a change of resistance between points A and B, as we've just seen. However, depending on whether you install link A or B, a long press of the transmitter pushbutton will either switch on the timer, or allow you to turn the load off or on, regardless of the power control setting.

When pin 17 of IC1 goes high in response to a valid transmission, C2 starts to charge via R4. If the transmitter button is held pressed, the voltage across C2 will reach the upper hysteresis level of the input to IC2b. When this happens, its output (pin 4) will go low and the output of IC2c (pin 6) will go high. This disables IC3 so it doesn't clock when the transmitter button is released.

As a result the resistance setting doesn't advance when the transmitter pushbutton is released, but instead the toggle flipflop formed by IC2e and d (and associated components) is able to change state.

Assume that the output (pin 10) of IC2e is high and the output (pin 8) of IC2d is low. This is the timer off or triac off condition, depending on the setting of link A or B.

When the output of IC2c goes high, the change is passed to IC2e via C4 and to IC2d via C5. The input of IC2e is held low by R16, but the input of IC2d is held at around two thirds of the supply voltage by resistors R15 and R14. As a result, the input of IC2e goes high, sending its output low, while the input to IC2d remains a high.

This causes the flipflop to change state rapidly, by the feedback action via R15 and R16. Another positive pulse, either through D1 or D4, will reset the flipflop back to its original state. (A simpler circuit could have been achieved with two cross-coupled NOR gates, but this would have meant another IC on an already crowded circuit board.)

When the output of IC2d (pin 8) goes high, transistor Q1 is turned on via R19, which turns on LED11. If link B is installed, the LED selected by IC3 will turn on and its series resistance will be connected across terminals A and B.

So, holding the transmitter pushbutton long enough for C2 to charge causes the toggle flipflop to change state. If the original state is for Q1 to be on, the next state will be Q1 off.

This will turn off any LED in the resistance control network, and the load will turn off.

Another long press of the transmitter pushbutton switches Q1 on, and the LED previously turned off now switches on, returning the value of the resistance network to its original setting. The same effect can be achieved by operating SW2. This switch simply pulls the reset input of IC3 high, resetting the counter to zero. Like SW1, this switch is optional and was not included in the prototype.

Timer section

If link A is fitted, the LEDs in the output circuit of IC3 now have a path to ground. As already explained, when a long transmitter pulse is received, the flipflop of IC2e and d toggles.

When the output of IC2e is high, it removes the reset condition on IC4, which now starts to count the pulses from the low frequency Schmitt trigger oscillator of IC2f. After 8192 pulses from the oscillator, output pin 3 of IC4 will go high. This now toggles the flipflop back to its original state via D4 and also resets IC3 via D5.

Because all outputs from IC3 are now low, the resistance across terminals A and B is a maximum and the triac is turned off. For the values of components R17 and C6 as shown, the timer gives a delay of about one hour.

This time can be changed, where increasing R17 increases the time delay. If R17 is set to 100k, the time delay is around 30 minutes. Fitting a potentiometer to the PCB is impossible, due to the limited space, but an off-board control could be added if required, assuming you have space on a front panel.

Power to the control circuit is taken directly from the voltage across the triac. When the triac is off, the full 240V AC supply is across it. However, as the conduction angle of the triac is increased, the available voltage across the triac falls, eventually to zero if the triac conducts for the full 180° of each half cycle. However, as in most triac controller circuits, the triac is never completely on, so there's always a sufficient voltage drop across it to maintain an adequate supply voltage to the receiver/timer PCB.

The AC across the triac is rectified by D7, and the resulting half-wave supply is smoothed by C12. ZD1 was included not so much as a regulator, but mainly to ensure the supply rail did not rise too high when the triac was off.

The 240V AC voltage is connected to D7 via R30 and C11. The capacitive reactance of C11 at 50Hz is around 14.5k ohms, which causes most of the voltage drop. Being reactive, no power is wasted and no heat is generated by the capacitor.

Resistor R30 limits the current in the rectifier circuit during initial switch-on, and normally dissipates less than 0.5W. However, a 5W wirewound resistor is needed to withstand the initial surge at switch on.

That's all for now. The construction details will be provided in the second of these articles. ❖

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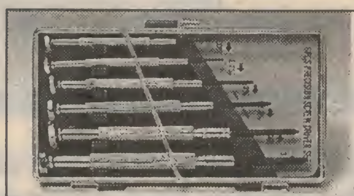

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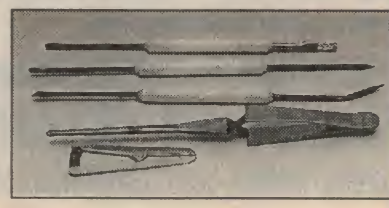

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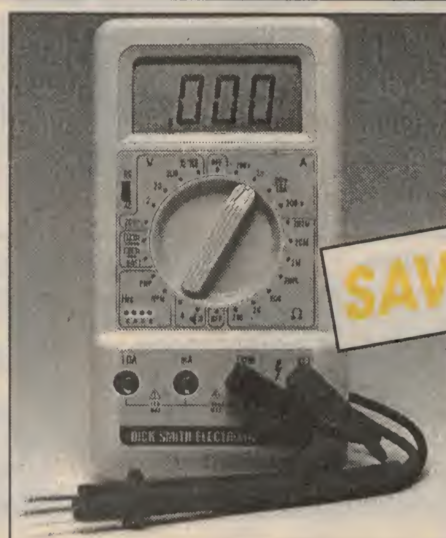

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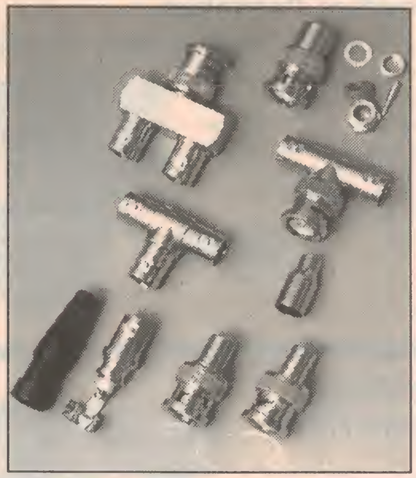

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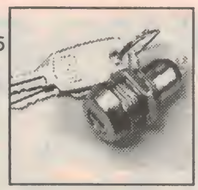

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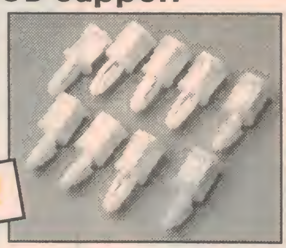

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Circuit & Design Ideas

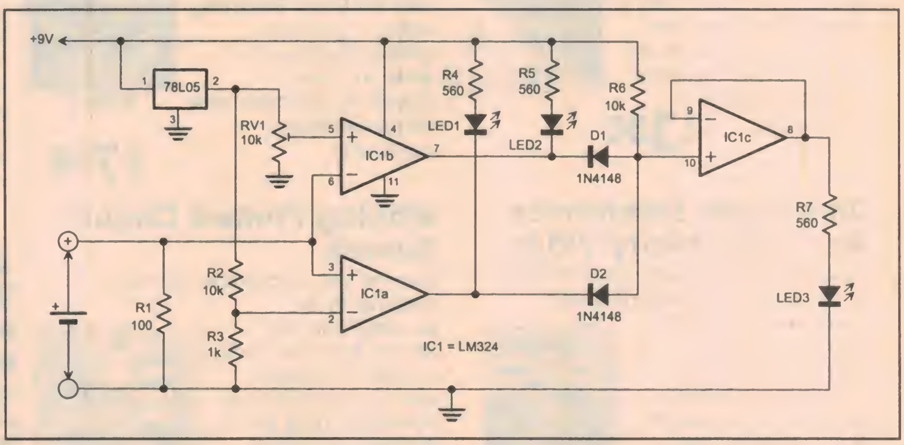
Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

NiCad cell tester

I have a collection of ageing AA NiCad cells which I use to power a personal stereo and a radio. Frequently I find that cells which I presumed to be charged are not. This is either due to a loss of charge because too much time has passed since charging, or because the cell has reached the end of its lifetime due to dendrite growth and associated internal short-circuiting of the electrodes. This circuit gives an easy way to test these cells.

The cells are connected to a 100 ohm load resistor (R1) and the voltage tested with comparators IC1a and IC1b. A threshold voltage of 0.45V is derived by R2 and R3 from the 5V produced by the 78L05 voltage regulator, which is used here as a cheap voltage reference. If the cell voltage is below this value, LED1 is lit. This indicates a dead, internally shorted cell, as even discharged cells produce a voltage higher than 0.45V.

A charged cell is indicated by LED2, which turns on if the voltage threshold set by RV1 is exceeded. NiCad cells have a fairly flat discharge curve, so a careful setting of this value is needed, which also explains the need for a voltage reference. A completely charged cell has a voltage of 1.35V which drops rapidly to about 1.30V over the first few percent of discharge. This is followed by a subsequent gradual decrease to about 1.25V before its capacity is exhausted, which is associated by a sharp drop of voltage. I chose a threshold value of 1.28V, which indicates a cell that is charged to about two thirds of its capacity.



A discharged cell is indicated by LED3, which lights up when the voltage is between the two threshold values. The signal for this is derived from the output of the two comparators by the AND gate formed by diodes D1 and D2 and pull-up resistor R7. The outputs of IC1a and IC1b are both a logic high if the cell voltage is between the set thresholds. IC1c is a buffer to drive LED3.

The circuitry can be powered by a 9V battery and built into a small box with an AA cell holder mounted on top for easy insertion of the NiCad cell to be tested.

Dr Peter Hauser,
University of Auckland, NZ. **$40**

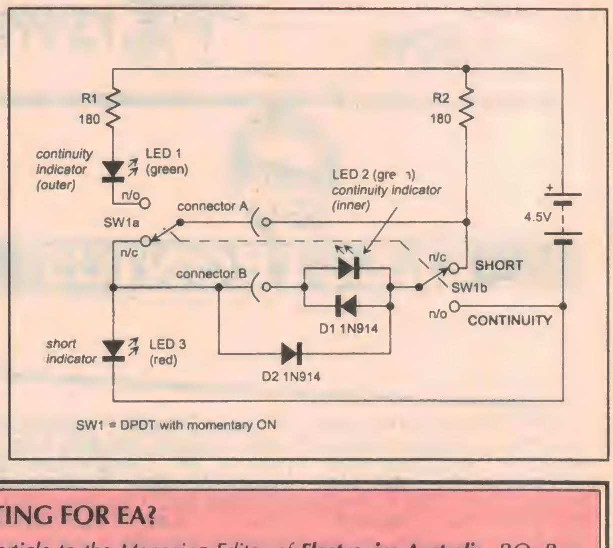
Cable tester

I could not resist the challenge presented by Jim Rowe's *EA* November 1994 construction project: the In-a-Flash Cable Checker. My cable-tester circuit runs on a 4.5V supply, using three AA cells, which gives a longer battery life at less cost. It also uses fewer components.

The tester indicates a short-circuit (red LED) between the inner and outer conductors whenever a defective cable is connected. When operated, the spring-loaded DPDT (toggle or slide) switch enables the 'continuity' function, and either one or both green LEDs will light if the appropriate conductors are intact.

If there's an inner-outer short, but the switch is operated anyway, only one continuity LED will light, even though both conductors may be intact. So any short circuits must be eliminated first to get valid test results of continuity. The circuit draws no current when not being used and so it doesn't need an on/off switch.

Murray McGregor,
Dunedin, NZ. **$40**



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Voltage & continuity tester for cars

This circuit was originally designed to check automotive electrics, but it can also be used as a general purpose voltage detector/continuity checker.

The test leads are connected to the circuit via R5. Transistors Q1 and Q2 are the on-off switch for the tester. If there's no circuit through the probes, transistors Q1 and Q3 are switched off as no current can flow through the base of either device because of the combined breakdown voltage of Zl, Dl, D2 and Z2, (around 13.6 volts).

Thus if Q3 is switched off, Q2 is also off, isolating the supply (Vcc) to the rest of the circuit.

If there's a circuit through the probes, Q1 will switch on (via Z1, D1, and R5) and power to the circuit is supplied via Q1 and D3. Q1 also gives a high to pin 5 of IC1b, which allows the oscillator formed by IC1b, R7, R9 and C2 to oscillate. This signal is buffered by Q5 and Q6, lighting LED2 and causing a continuous tone from the piezo speaker.

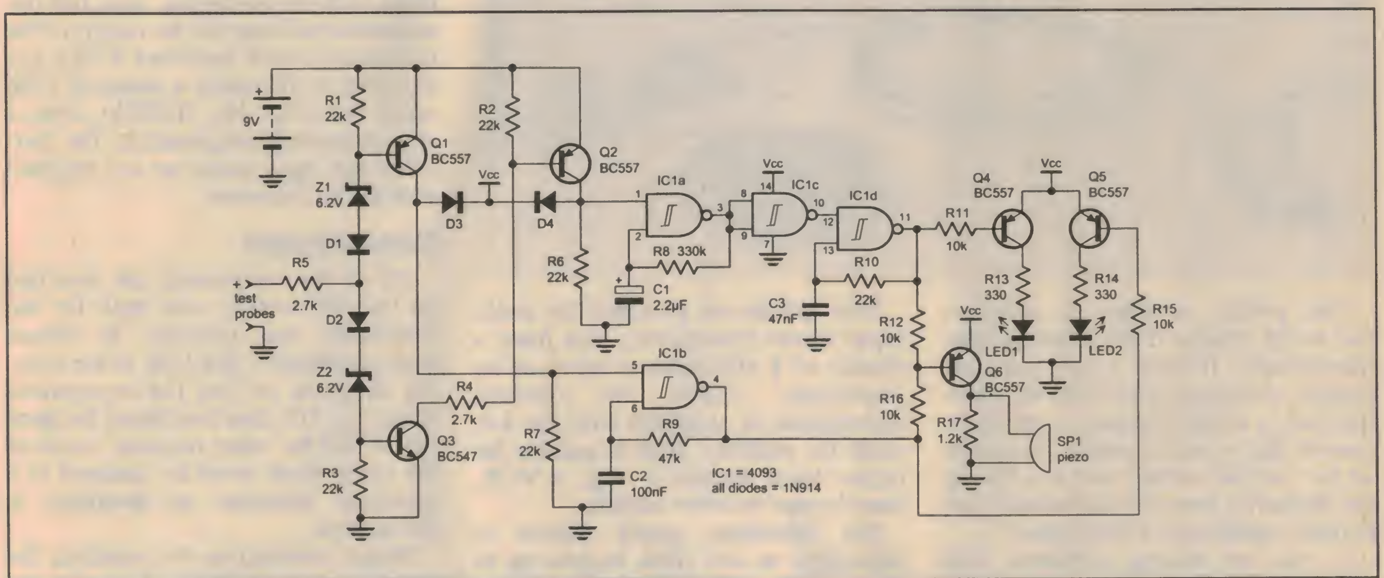
If the test probe is connected to a voltage of between nine and 12 volts, Q1 turns off and Q3 turns on. This causes Q2 to switch on, and the voltage supply to the circuit is now via D4. This time pin 1 of IC1a goes high and the low frequency oscillator around IC1a operates.

This oscillator is used to 'gate' the tone produced by the oscillator around IC1d to produce a 'beeping' tone through the piezo speaker (via Q6). It also causes LED1 to flash on and off (via Q4). Note that IC1 and transistors Q4-6 are connected to the point marked Vcc, and not directly to the battery. LEDs 1 and 2 should be different colours for best effect, or they can be a dual colour LED.

The device is simple to use when checking auto electrics. Connect the (-) test lead to the car chassis, then probe around the problem area with the (+) test lead. If you touch a point connected to earth, LED2 will light and the unit will emit a continuous tone. If the point is connected to 12 volts, LED1 will flash on and off, and the unit will emit a beeping tone. Note that the tester should not be used for checking mains, or any AC voltages.

When both the LEDs are off, the battery is automatically disconnected, so it should last quite a long time. As well you can never forget to turn it off.

Bruce Colledge,
Keperra, SA. **$45**



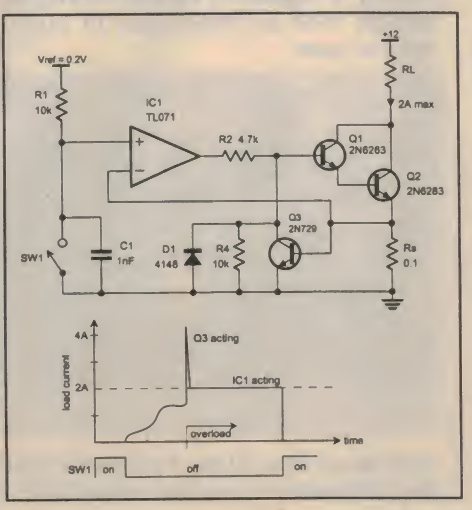
Current limiting switch

This switch consists of a power stage, (Q1 and Q2), and regulators IC1 and Q3. It allows a load to be switched on and off, and features current limiting and fast-acting isolation if there's an overload.

The op-amp compares the voltage developed across Rs to a 0.2V reference voltage. The voltage developed across Rs is proportional to the load current and this voltage is applied to the inverting input of the op-amp.

While Vref is higher than the voltage across Rs (SW1 is off), the output of IC1 is high, which turns on the power stage and allows current to flow in the load. When the voltage across Rs approaches Vref (0.2V), IC1 begins to limit its output voltage and therefore the current flowing through the load.

The circuit remains in this current limiting mode until either the overload is removed and the load current falls to within its normal range, or if SW1 is closed.



There are two forms of feedback in the circuit to ensure rapid turn off in the event of a severe overload. The first is via IC1 and the second is through Q3. The operating speed of a transistor is usually faster than that of an op-amp, which means the output of IC1 won't respond immediately if there's a severe overload.

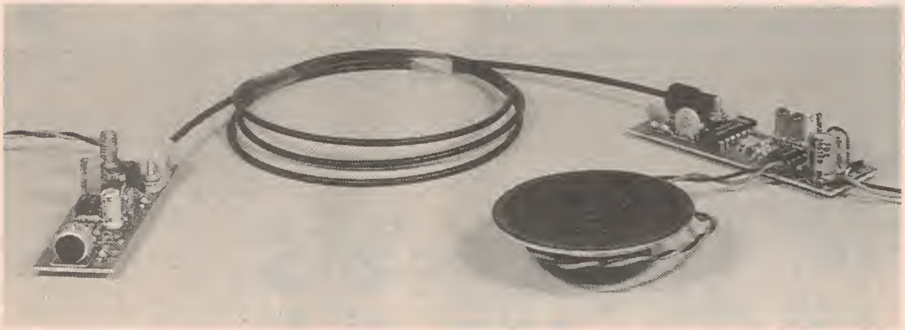
In this circuit, when the voltage across Rs reaches 0.5V or so, the base-emitter circuit of Q3 is biased on, causing the transistor to turn on. This removes the voltage from the base of Q1, turning off the power stage, and therefore the load current. The load is turned off when SW1 is closed.

N. Lavrentiev,
Kaliningrad, Russia. **$35**

DSE 'Discovery Series' Construction Project:

AUDIO LINK USING OPTICAL FIBRE

This further release in the new Discovery Series of learning kits from Dick Smith Electronics is an easy to build 'simplex' (i.e., one way) audio communications link, using a light beam in an optical fibre cable. It not only provides an excellent 'hands on' introduction to optical fibre transmission, but is also very practical for communications in noisy or otherwise harsh environments. The complete kit for this project is available from DSE's stores (Cat. No. K-2803) for $49.95.



This project provides an introduction to the modern field of optical fibre transmission. It's also a very practical project, providing you with an audio link that is totally immune to the interference that would normally be picked up by metallic cables, and not having the frequency response limitations due to their capacitance or inductance.

If you are having problems with noise being picked up by the wiring for your intercom, remote sensor, extended microphone connections, etc., due to nearby mains wiring, fluorescent lights or any other electrical noise source, then this fibre-optic link may be the solution.

DSE's kit for the project includes a 1mm optical fibre cable and a matched pair of optical transmitter and receiver devices. Signals are transmitted over the optical fibre by modulated light at a wavelength of 660nm or 820nm (1nm = 10^{-9}), depending on the particular transmitting device supplied with the kit. The light is amplitude modulated and provides a one-way, single audio channel, with a frequency response up to 35kHz.

The transmitter and receiver device packages have integral screw-on clamps that give a reliable mechanical and optical termination for the cable.

Two options are provided for audio input to the transmitter; you have a choice of a microphone input or an 'auxiliary' input. An electret microphone is supplied with the kit, while the auxiliary input is suitable for higher level signals — e.g., a VCR, tuner or tape recorder outputs.

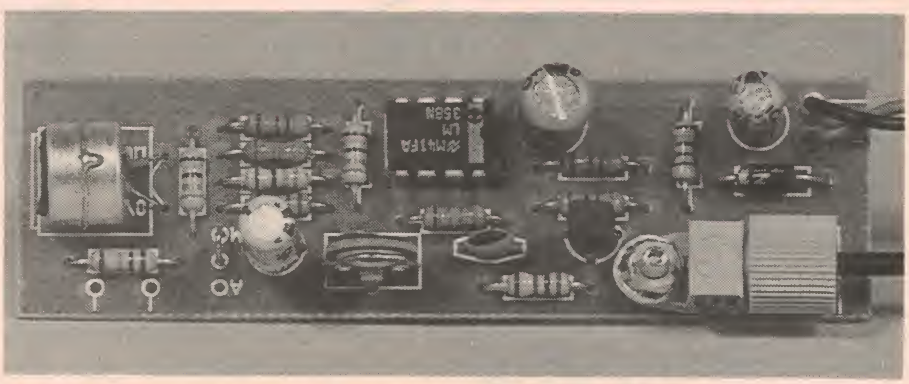
The transmitter output power is adjustable to suit fibre lengths up to about 20m, and the receiver has a signal level indicator which allows you to set the optimum output power for minimum power consumption. The receiver is capable of directly driving a speaker with an impedance of eight ohms or more.

Power for the kit can be supplied from two 9V batteries, one for the transmitter and one for the receiver. The transmitter and receiver PCBs are designed to fit inside a standard DSE zippy box (Cat. No. H-2855) without any mounting components. The batteries and zippy boxes are not supplied with the kit, however.

Construction

All of the components are mounted on two PC boards, one each for the transmitter and receiver. To mount each component, first look at the overlay diagram to find the component name, e.g. D3, then look down the parts list to find the value required. Some of the components must be mounted in a particular direction as described in this section.

Begin construction by installing the resistors on both PCB's. The parts list includes a colour code table for identifying each value. The last band of the colour code is the one furthest from the other bands. Resistors can be mounted in either direction, but it is good practice to mount them with their colour



A close up view of the transmitter board, with the electret microphone insert at the left hand end and the optical fibre transmitter at lower right.

codes all in the same direction for ease of reading the values later.

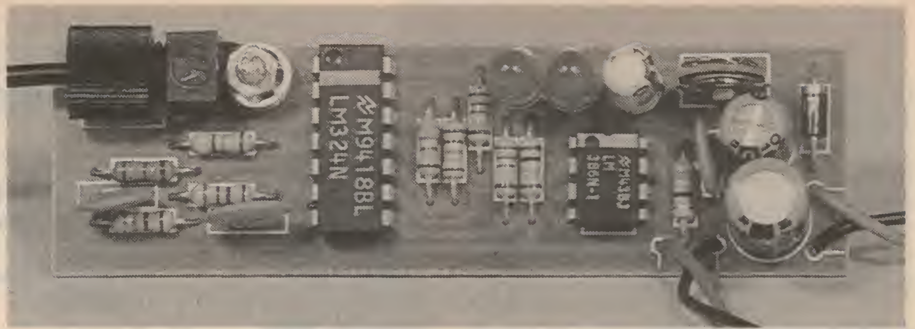
Using wire cut from the resistors, install the link on the transmitter PCB which determines whether the microphone or auxiliary input is to be used. The centre pad of the three is linked to the 'A' pad for the auxiliary input and to the 'M' pad for the microphone.

Next mount the diodes D1 and D2. These have to be mounted in the right direction, with the stripe on the very end of the diode corresponding to the striped end shown on the overlay diagrams.

Next mount integrated circuits IC1, IC2 and IC3. Mount them so that the end with the notch in it is orientated as shown on the overlay.

Next mount transistor Q1 on the transmitter PCB. Position it so that the flat face is towards R11, as shown on the overlay. Do not push it down too hard towards the PCB, as this will spread the leads excessively and may damage the internal connections.

Now mount the capacitors. Note that C1, C3, C4, C7, C8 and C10 are electrolytic types which must be mounted in the correct direction. The negative lead is marked on the side of the capacitor with a negative (-) sign and the other lead, which is not marked, goes to the position that is marked with a positive sign (+) on the overlay. The other capacitors (C2, C5, C6 and C9) can be mounted in eitherdirection.



And here's a close up view of the receiver board, showing the fibre optic receiver diode at upper left. The LEDs are used to set up the transmitter output for optimum performance with a given length of optical fibre.

Next mount the two trimpots VR1 and VR2. It's a good idea to bend the leads over after they are inserted into the board to give them a better mechanical hold on the board, rather than just relying on the solder joints.

Lastly, mount the optical fibre transmitter and receiver, bolting them to the board before soldering. The microphone is best mounted on the PCB using surplus lead wires cut from the resistors; otherwise use a shielded cable to connect it to the PCB.

If the PCB's are to be installed in zippy boxes, then a slot will have to be cut in the end of each box so that the optical fibre does not have to bend when the PCB is placed into its slot.

Connecting the cable

Although the project is designed to use low cost plastic optical fibre cable, which is fairly rugged, preparing and fitting the cable still needs to be done carefully. Here are the recommended steps:

1. Cut the fibre end squarely, with a sharp blade or hot knife.
2. Strip the jacket back with an 18-gauge wire stripper, to expose 2.5-4.5mm of bare fibre core. Avoid nicking the fibre core.
3. Insert the fibre end through the locking nut and into the connector, until the core tip seats against the moulded lens inside the device package.
4. Screw the lock nut onto the device package to lock the fibre in place.

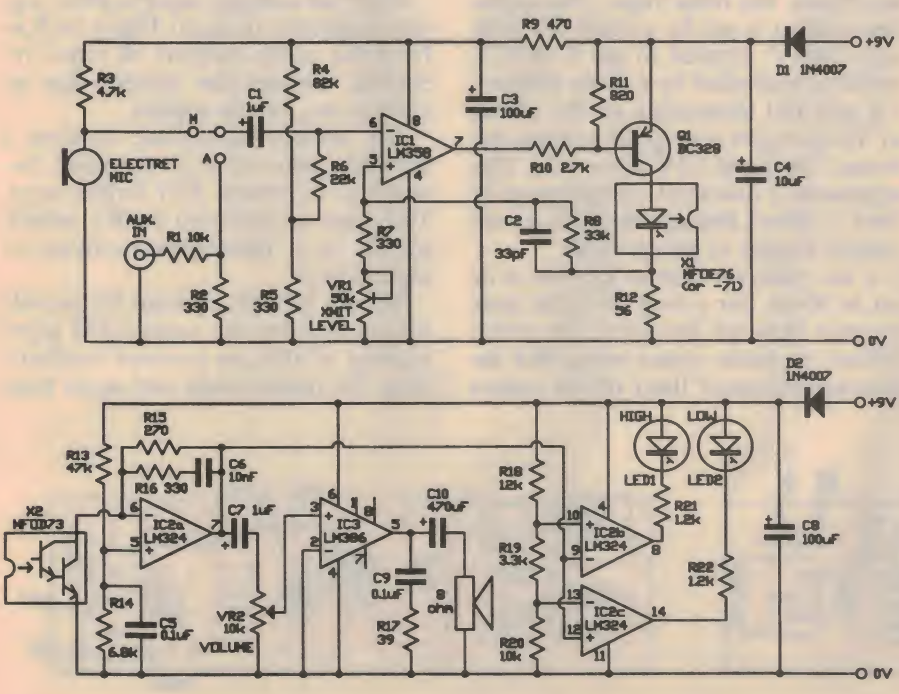
Transmitter level

After the optical fibre has been terminated at both the transmitter and receiver ends, carefully check the components and wiring on both boards to make sure you haven't made any mistakes (swapped components, polarised parts reversed, etc.) or left any solder bridges between pads. Then if everything seems OK, connect power to both the transmitter and receiver. If batteries are being used, make sure that they are in good condition or else the level will not be set correctly.

With little or no audio input to the transmitter, adjust trimpot VR1 on the transmitter PCB until both LEDs on the receiver PCB are off, or glowing dimly with equal brightness.

If cable lengths greater than a few metres are to be used, it is a good idea to replace VR1 with a smaller value trimpot (say 20k, or even 10k) so that the adjustment is less delicate.

To work out the optimum value of the trimpot for a particular cable length, first set up the transmitter level with the 50k trimpot supplied. Remove the 50k trimpot and measure the value it is set to (or estimate it from the rotation angle



The schematic for the transmitter board circuitry is shown at upper left, with that for the receiver board below it.

of the sliding contact) and then replace it with a trimpot with a total resistance of roughly twice the measured setting. For example, if the 50k trimpot is set to about 5k (i.e., only 10% from the fully clockwise end), then replace it with a 10k trimpot and repeat the adjustment procedure.

Alternative inputs

If microphones other than electret types are to be used with this project, then try the following suggestions.

For microphones producing less than 50mV peak to peak, connect them to the electret microphone terminals and remove resistor R3.

For higher level microphone outputs, use the auxiliary input and vary the values of R1 and R2 until the required signal reduction is achieved.

Signals applied to the auxiliary input are reduced by a factor of (R1+R2)/R2; for the values shown on the schematic this reduction factor is 31.

Alternative outputs

If the receiver output is going to be fed into an external amplifier, then it is a good idea to leave IC3 (the LM386) out of the circuit and take the output from across the centre and ground terminals of the volume control VR2. The signal level at this point can reach levels of up to 3Vp-p, so it is suitable for direct connection to auxiliary or power amplifier inputs — but not to microphone or similar inputs, without extra attenuation of the output.

How the link works

First of all, let's look at the transmitter unit. The light which acts as the 'carrier' for our audio signals is 'launched' into the end of the optical fibre by an infrared LED, inside the X1 transmitter device. The amplitude or intensity of this light is proportional to the current in the LED, to a high degree of linearity.

SPECIFICATIONS

Transmitter	
Frequency response	8Hz-100kHz
Transmitter device	MFOE71, an 820nm LED, or MFOE76, an 660nm LED
Light power output	100uW approximately
Supply voltage	9V DC (7.5V min, 10V max)
Supply current	3-60mA depending on power output (typ. 5mA for 4m fibre)
Optical Fibre	
Fibre type	1mm diameter plastic
Usable fibre length	Approximately 0-20 metres
Attenuation	Approx. 3dB/m at 820nm, or Approx. 0.25dB/m at 650nm
Receiver	
Receiving device	MFOD73 photo Darlington
Peak response wavelength	820nm
Audio output power	0.25W maximum
Frequency response (overall)	50Hz-35kHz from speaker output 10Hz-35kHz from volume control
Supply voltage	9V DC (7.5V min, 10V max)
Supply current	18mA at optimum tx power

This current is in turn made proportional to the audio input voltage by operational amplifier IC1, which is one of two op-amps in the LM358 IC package. The LED current is accurately controlled by means of a feedback voltage from across R12, which is of course proportional to the current.

The LED must have a constant current through it (called a 'quiescent' current) when there is no audio signal applied — so that the audio signal can cause the LED current to vary above and below this fixed value. This quiescent current is set by a small DC voltage (34mV) applied to pin 6 of IC1, which is multiplied by a factor between 1.6 and 100 (depending on the setting of VR1) to give a range of voltages between 54mV and 3.4V across R12. This represents a quiescent current range of 1mA to 60mA through the LED, to suit various lengths of optical cable.

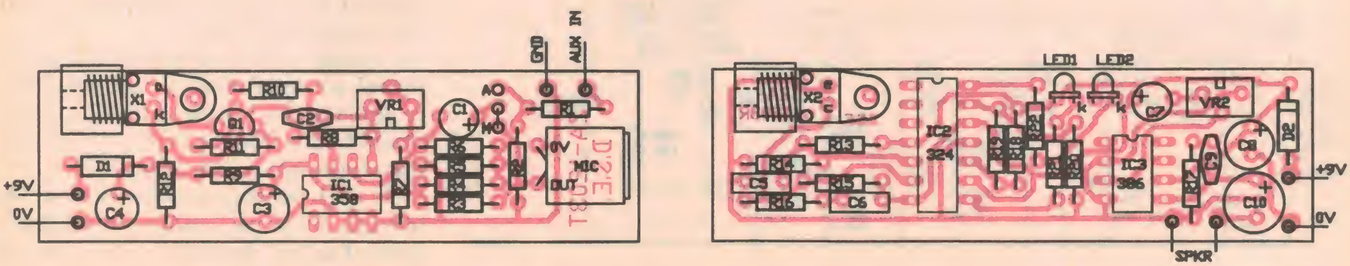
If the quiescent current happens to be set to 60mA, for a long fibre, the peak current through the LED can reach 100mA on audio signal peaks. But the guaranteed upper limit of the output current from an LM358 is in the order of 20mA, so Q1 was used to provide the necessary current gain.

The audio input is applied to pin 6 of IC1 via C1, and modulates the DC bias voltage at that point. The maximum amplitude of the audio signal that can be applied (to pin 6) is about 40m Vp-p, which produces a 60% amplitude modulation of the LED current. This depth of modulation gives a good compromise between efficiency and distortion.

When the auxiliary input is used, signal amplitudes of up to 1Vp-p such as from the audio outputs of video recorders, compact disc players, tape recorders, etc., can be applied.

The electret microphone requires a DC bias current for its operation, because of its inbuilt FET buffer stage. This bias is provided by R3, which results in a microphone current of about 0.5mA.

Resistor R9 and capacitor C3 provide decoupling for the supply and input biasing of IC1, to prevent feedback from the output stage and noise from



Here are the PCB overlay diagrams for the transmitter (left) and receiver (right) modules, to guide you in fitting all of the components to each board. Take care to fit the polarised parts the correct way around.

the power supply. Capacitor C4 and diode D1 provide filtering and reverse polarity protection respectively, from the power supply.

Now let's turn to the receiver board schematic. The device which receives the light from the optical fibre is a photo Darlington transistor (X2), which has its output collector and emitter available for connection to the receiver amplifier. This device has the advantage over other types of detectors in being very sensitive; however it is also very slow, making it useful only for low frequency transmission applications.

The collector current in the output transistor is proportional to the light intensity received. To extend the upper frequency limit as far as possible, the output of the Darlington is connected to a low impedance AC 'virtual earth' point at pin 6 of IC2a. This greatly reduces the effect of internal feedback due to the collector-base capacitance ('Miller effect'), which would otherwise limit the frequency response.

The DC voltage at pin 6 is set to 1V, a value as small as possible to minimise power dissipation, but greater than the collector-emitter saturation voltage of the Darlington device. With the transmitter set to its optimum output level, the current through the Darlington is 10mA.

The effective load for the Darlington output is the series-parallel combination of R15, R16 and C6. The value of R15 is chosen to give the maximum output swing for a 60% modulation depth, with R16 and C6 used to prevent positive feedback at higher frequencies. A voltage proportional to the Darlington output current appears at pin 7 of IC2a, and the AC component of this voltage is then fed to the volume control via C7 so that a controlled proportion can be fed to the power amplifier IC3.

The current in the detector for a fixed transmitter output can vary over a wide range due to different fibre lengths, fibre termination quality and receiver current gain. Rather than having the transmitter at a constant high power level, with some sort of automatic gain control (AGC) at the receiver, the designer took the option of having a variable transmitter power with a signal level indicator at the receiver. This way the power consumption is minimised, and biasing for minimal distortion is ensured.

The signal level indicator uses a 'window comparator' formed around IC2b and IC2c. When the DC signal voltage at pin 7 of IC2a exceeds the voltage at pin 10 of IC2b, then the 'high' LED will come on due to the output of IC2b switching low; conversely if the voltage falls below the voltage on pin 13 of IC2c, the output of this op-amp will switch low instead and the 'low' LED will come on.

The transmitter output is adjusted so that the signal is between these two voltages, and both LEDs are off. The LEDs should glow with roughly equal brightness if there is a strong enough audio signal present, indicating symmetrical modulation.

The audio power amplifier uses an LM386, which has an internally fixed minimum voltage gain of 20 and can supply just over 1/4 of a watt into an 8-ohm speaker with the supply voltage used in this project.

Note that if this optical link is to be used with relatively long optical fibre cables, such that the quiescent transmitter LED current needs to be set to more than 15mA or so, you'll need to run the transmitter board from a set of six AA-size dry cells, rather than one of the small 216-type 9V batteries. ❖

PARTS LIST

Resistors

0.25W 1% metal film unless stated:

		4-band 1%	5-band 1%
R1,20	10k	Brn Blk Org Brn	Brn Blk Blk Red Brn
R2,5,7,16	330 ohms	Org Org Brn Brn	Org Org Blk Blk Brn
R3	4.7k	Yel Vio Red Brn	Yel Vio Blk Brn Brn
R4	82k	Gry Red Org Brn	Gry Red Blk Red Brn
R6	22k	Red Red Org Brn	Red Red Blk Red Brn
R8	33k	Org Org Org Brn	Org Ord Blk Red Brn
R9	470 ohms	Yel Vio Brn Brn	Yel Vio Blk Blk Brn
R10	2.7k	Red Vio Red Brn	Red Vio Blk Brn Brn
R11	820 ohms	Gry Red Brn Brn	Gry Red Blk Blk Brn
R12	56 ohms	Grn Blu Blk Brn	Grn Blu Blk Gld Brn
R13	47k	Yel Vio Org Brn	Yel Vio Blk Red Brn
R14	6.8k	Blu Gry Red Brn	Blu Gry Blk Brn Brn
R15	270 ohms	Red Vio Brn Brn	Red Vio Blk Blk Brn
R17	39 ohms	Org Wht Blk Brn	Org Wht Blk Gld Brn
R18	12k	Brn Red Org Brn	Brn Red Blk Red Brn
R19	3.3k	Org Org Red Brn	Org Org Blk Brn Brn
R21,22	1.2k	Brn Red Red Brn	Brn Red Blk Brn Brn
VR1	50k 5mm	vertical trimpot	
VR2	10k 5mm	vertical trimpot	

Capacitors

C1,7	1uF 50VW RB electrolytic
C2	33pF 50V ceramic
C3,8	100uF 16VW RB electrolytic
C4	10uF 16VW or 35VW RB electrolytic
C5,9	0.1uF 50V ceramic (100n, 104)
C6	10nF 50V ceramic (10n, .01, 103)
C10	470uF 10VW RB electrolytic

Semiconductors

D1,2	1N4007 power diode
LED1,2	5mm round red LED
Q1	BC328 PNP small signal transistor
IC1	LM358 dual op-amp
IC2	LM324 quad op-amp
IC3	LM386 low voltage power amp

Miscellaneous

X1	MFOE76 or MFOE71 optical fibre transmitter
X2	MFOD73 optical fibre receiver

Transmitter PCB, 78 x 23mm, code ZA1203T; receiver PCB, 78 x 23mm, code ZA1203R; 8-ohm 1/4W speaker; electret microphone insert; 2 x 9V battery snap connectors; length of plastic optical fibre cable (PG-S-CD1001); hookup wire, tinned copper wire, solder, machine screws, nuts and washers.

Mini Construction Project:

A CALIBRATED RF DETECTOR PROBE

If you do much work at RF, a detector probe makes a very handy addition to your measuring setup — allowing you to make RF signal measurements with your DMM. Usually the only problems with a home-made probe are ensuring that it gives reliable readings at higher frequencies, and also knowing what its linearity is for low signal levels. Providing you build this design as the author describes, it should perform according to his measured calibration curves...

by KEITH DOOLEY, VK5BGZ

Perhaps you think an RF detector probe would be a useful addition to your array of test equipment. Or you may have already made one, along the lines of the one published in this magazine in February 1991, as part of an article on a two-metre transceiver designed by Dick Smith Electronics, but would like to have one that's calibrated. If either of these situations applies to you, read on.

It is difficult for even the serious hobbyist to calibrate such a probe, so you don't really know what the RF voltage is on the tip for a particular reading on the meter connected to the probe output. You would have some idea of course, from the fact that the rectifier (detector) is a voltage doubler type and for an ideal rectifier and infinite load resistance, there would be a DC voltage 2.8 times the RMS input voltage across the output. But the rectifier isn't perfect and the load resistance isn't infinite. So what effect does this have on the calibration of the probe?

Well, shown here are some calibration curves for the probe constructed by the writer, in a similar manner to that described. The construction details of the probe are given again, in sufficient detail that the one described can be duplicated. So hopefully if you build yours with the same basic construction, the calibration curves shown should be appropriate to yours as well.

Construction

The barrel of the probe is a 120mm length of thin walled brass tube with an OD of 7.9mm, of the type available from hobby shops and some hardware stores.

Four holes are drilled in the tube in the locations shown in the drawing.

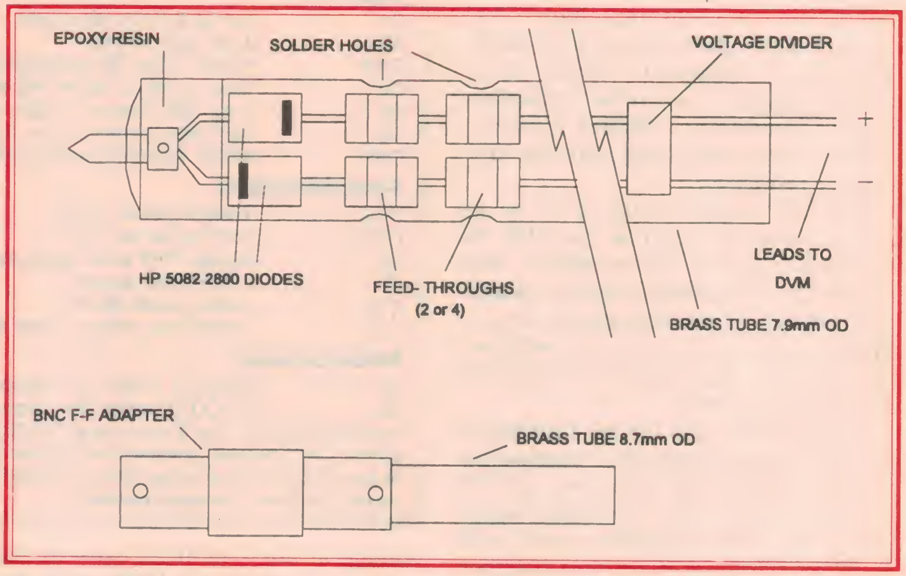


Fig.1: Diagram (a) at top shows the basic construction of the author's probe, built in a length of 7.9mm brass tube. Diagram (b) below shows how a BNC female-to-female adaptor can be modified for use with the probe.

The feedthrough capacitors are probably the most physically critical part of the assembly, as they must be soldered together closely enough to fit inside the tube and have their outer contacts soldered to the brass tube through the holes.

The value of the capacitors is not critical; any value from 200pF to 4.7nF would do, although values at these extremes would not be very appropriate at the extreme frequencies. The 1nF feedthroughs available from Dick Smith Electronics would be fine. If these are used, only two would be required rather than the four used in the prototype. 500pF units were used in my prototype as these provide better bypassing at high frequencies than the 1nF ones.

First off, file the capacitor flanges flat on two opposite sides. This must be done very carefully so as not to break or chip the ceramic insulation. Then solder two pairs of the capacitors together side by side, and carefully file the flange corners on the outer edges so that the assemblies will slide into the brass tube.

Next put the two diodes together, taking care that the polarity is correct. Twist the leads together at one end as close as possible to the glass bodies — but not so close as to stress the glass and break it, as happened with my first attempt! It is important here, though, to have as little lead length as possible for the probe to work at UHF.

For the probe tip I used the centre pin from a BNC plug. The reason for this was to make the probe fit a BNC adaptor, which is described later. The pin is

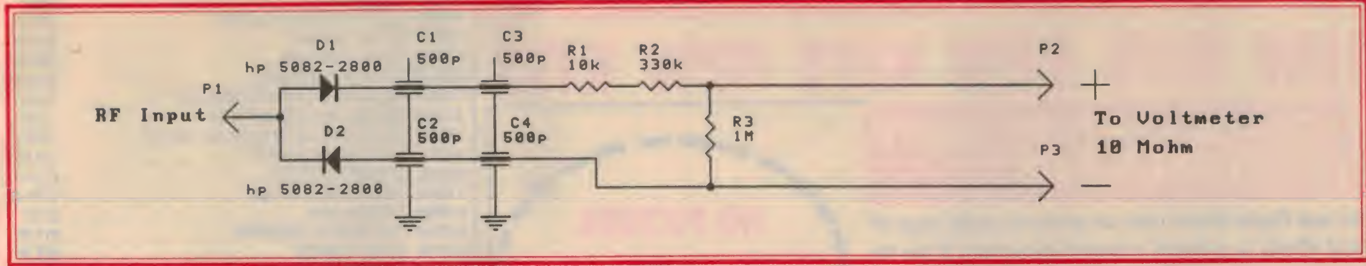


Fig.2: The schematic for the RF detector probe, which uses two hot carrier diodes in a voltage doubler circuit.

soldered on to the twisted diode lead junction, close to the diodes but taking great care not to overheat them.

The feed-through capacitor assembly (of either two or four capacitors) is attached to the 'other ends' of the diodes next, again leaving the diode leads as short as possible without risking damage.

You may find that these capacitors have a space though the central tube, where the centre feed-through conductor is soldered to the coating on the inside of the ceramic tube. If this is the case, the capacitors can be slipped over the diode wires and soldered in place with a minimum of heat — again so as not to damage the diodes. The centre wire can be simply removed from the capacitor by heating it with a soldering iron, leaving the required gap to feed the diode wires through.

The voltage divider on the output side of the probe can be attached next, or alternatively it can be placed at the banana plug end of the leads and covered with heatshrink tube. If the 10k resistor is omitted the calibration plot will be lifted by about 3%, bringing it closer to the one to one at low frequencies.

Next solder the wire leads to the assembly, again being careful about polarity. I used the nice and very flexible wire with silicone rubber insulation, available from DSE and other stores.

With the leads connected, test the assembly for shorts, correct polarity and functioning of the diodes and insert it into the brass tube. The outer connecting flanges on the capacitors should be opposite the solder holes, with the probe tip pin protruding 5mm from the end of the tube. Run enough solder into the holes to ensure that the outer flanges of the feedthroughs are reliably connected to the tube and held in position; then just enough more to fill the holes neatly, without overheating everything. The tip pin may need to be moved slightly to centre it in the end of the tube. Now run a little five-minute epoxy resin in around the pin, and wait the 20 minutes or so it takes for the epoxy to harden.

Fit the banana plugs to the meter ends of the leads and your probe should be ready for use. You may wish to attach an earth wire to the barrel of the probe, but the inductance of this will cause significant reactance at the higher frequencies. There is usually some earth conductor close to the RF point you're measuring, that the probe barrel can be held against to take the reading.

An alternative, where BNC connectors are being used, is to make a BNC adaptor for the probe. This is where the BNC pin comes in. It mates with the centre conductor of a female-to-female BNC barrel adaptor.

The next size of brass tube up from that used for the probe barrel is 8.7mm OD, and this is a nice sliding fit over the probe. A lathe is required to bore out one end of the BNC adaptor to take the larger size tube. The amount to be taken off is quite small; the ID of the adaptor only needs to be increased from 8.1mm to say 8.8mm. The 8.7mm brass tube, cut to about 40mm in length, is slid into the bored-out barrel adaptor and soft soldered in place, using a minimum of heat so as not to damage the adaptor's insulation.

Calibration

There are two calibration plots for my probe, as shown in Figs.3 and 4. Fig.3 shows the probe output plotted against frequency, for a constant 1.0V RMS fed to the probe. As can be seen, the response is within about +/-10% from below 100kHz to 200MHz. A 20% accuracy is all one can expect from a device

Continued on page 97

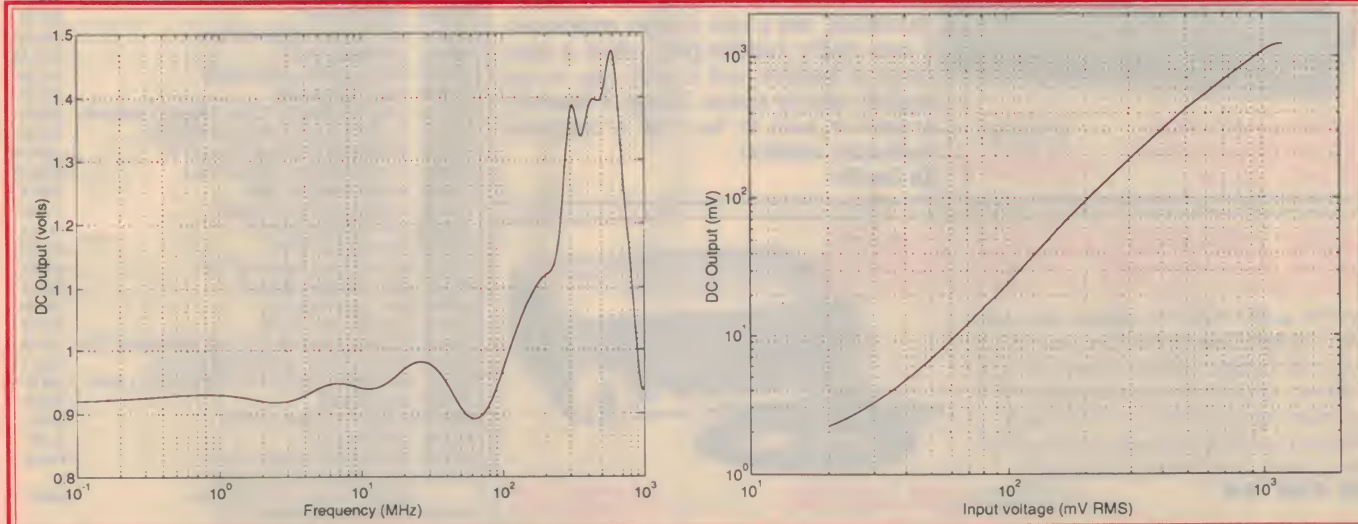


Fig.3:(left): The DC output voltage of the author's probe, plotted against frequency for a fixed one volt RMS input. As you can see it is within plus or minus 10% up to almost 200MHz. Fig.4 (right): The output of the probe plotted against input RF level at a fixed frequency of 20MHz, to show the probe's linearity characteristic.

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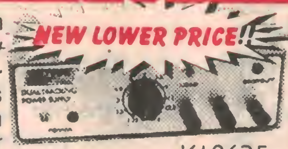

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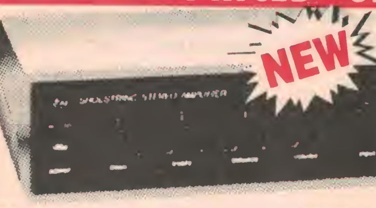

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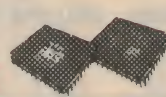

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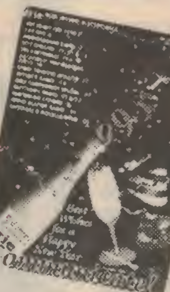

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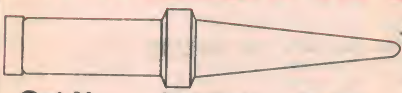

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T12512	PTBB8	430° C
T12514	PTC7	370° C
T12515	PTC8	430° C
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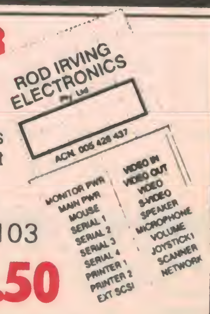

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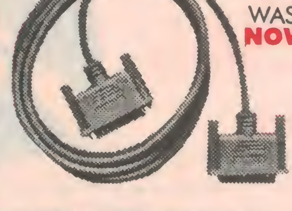

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Construction Project:

PUTTING THE VMAC RECORDER TO WORK

In the first of these articles, published last month, I described the operation and construction details of the 'Versatile Multiple Announcement Circuit' (VMAC), a very flexible solid-state audio recorder. Here are some suggestions and ideas for helping you to connect the VMAC to the real world, to take advantage of its ability to play individual messages on demand.

by BOB PARKER

One obvious use for the VMAC is in a car or other vehicle, to give warning messages when different problems arise. As a simple example, let's look at how you go about using it for warning of low oil pressure. Fig.1 is pretty self-explanatory. If your car doesn't have one side of the oil pressure warning switch grounded to the engine block, you might have to use the opto-isolator input circuit in Fig.5, connected across the oil pressure warning light itself.

Of course a car is only one of many possible VMAC applications. As Fig.2 shows, the VMAC can be triggered by external logic circuitry which shares the VMAC's ground connection. CMOS devices operating from +5 to +15V can drive it directly, while TTL and LSTTL outputs should have a pullup resistor of about 4.7k to the +5V supply, to guarantee correct logic levels. And remember that an input must be stable for 30ms before the Z86 will accept it!

If you want to trigger a VMAC input from a simple normally-open pushbutton, connect it as shown in Fig.3. Set that input's polarity switch to OFF.

Reed and mercury switches can be handy for indicating the state of doors, gates, and other structures you might want to keep an eye (or ear) on. If the switch is normally closed, follow the example in Fig.4; but if you want to know when it both opens and closes, refer to Fig.8 and its text for the details.

In some situations you might need to trigger a VMAC input from a light or some other DC-operated component which has neither terminal grounded, or operates from a negative power supply etc. This is where the opto-isolator circuit in Fig.5 would be used. The value of resistor 'R' in ohms is given by

R = (V - 1.5) x 200,

where V is the DC voltage across the device being sensed. The resistor's minimum power rating in watts is given by

P = (V - 1.5) x 0.005.

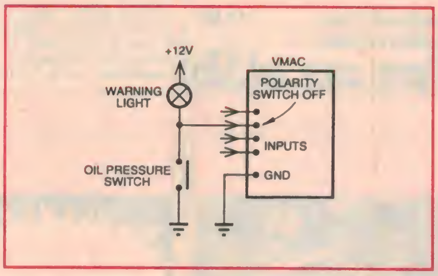


Fig.1: How to link the VMAC to your car's oil pressure switch.

The 4N28 or similar cheap opto-isolator and its resistor could be mounted on a small piece of properly-insulated 'matrix board', perhaps in the same box as the VMAC board itself.

Safe 240V triggering

You could use the circuit in Fig.6 to trigger a message from the presence or absence of 240V AC in some mains-operated system. Install a 240V neon bezel indicator (e.g. Jaycar SL-2634) at one end of a lightproof non-conductive tube, which illuminates a light-dependent resistor (e.g., Jaycar RD-3480) facing it — thus forming a kind of 'super opto-isolator'. Of course you'd have to keep the 240V wiring right away from the VMAC and its associated low voltage wiring, and people inexperienced with safe 240V wiring practices should NOT even think of attempting this!

As indicated in the first article, the VMAC can be triggered directly from an external positive voltage of +3V to about +20V, as depicted in Fig.7. The 10k resistor would be necessary if the external circuit's resistance to ground exceeds about 20k ohms, and you should install the diode in circuits

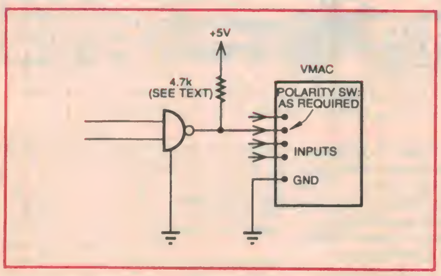


Fig.2: Interfacing the VMAC to external logic is also quite easy.

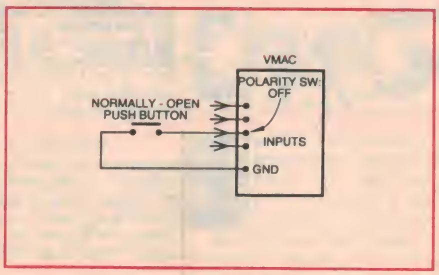


Fig.3: A simple push button sensor can also be connected very easily.

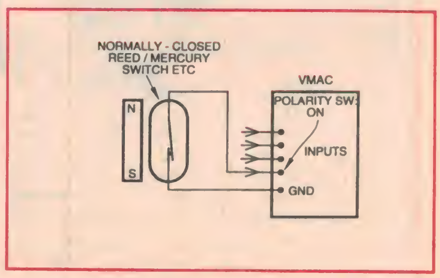


Fig.4: How a normally-closed reed or mercury switch can be connected.

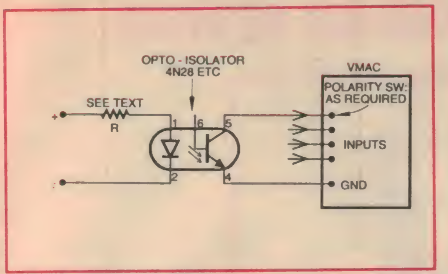


Fig.5: Using an opto-isolator to get full isolation from a DC trigger source.

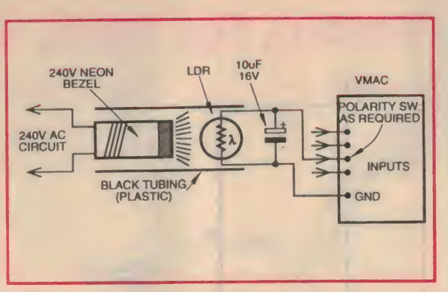


Fig.6: A home made 'super isolator' can be used with a 240V source.

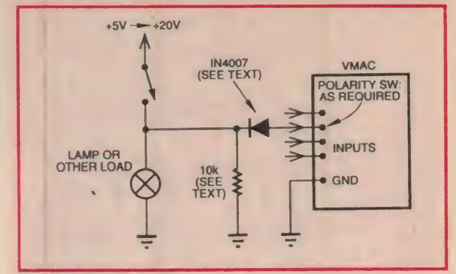


Fig.7: Triggering from a DC circuit which shares the VMAC's ground.

where the voltage exceeds about +20V. (We don't want too much current being injected into VMAC's +5V supply via its input pullup resistors.)

Dual polarity triggering

Fig.8 shows how you can use the VMAC to indicate both conditions of a trigger source. This is applicable to all of the preceding connection suggestions. You connect two inputs together and drive both of them from your switch or whatever. On one of these inputs you set the polarity switch to trigger on a 'high', and the other on a 'low' voltage condition. You'd probably set both inputs' repeat switches to OFF, too.

Then you record two appropriate messages, one for the 'high' trigger condition, and one for the 'low'. Just remember that if the input is changing repeatedly and quickly, the VMAC can play the wrong message last, as explained in the first article.

'Lights on' reminder

If you've installed a VMAC in your car, and would like it to warn you when the parking/headlights have been left on, follow the circuit in Fig.9. As you can see, the ignition or

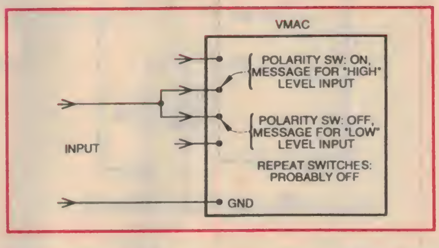


Fig.8: How to get messages for both states of the same trigger input.

'accessories' supply not only provides +12V power via its diode to the VMAC board, but is connected as a 'low'-triggering input as well.

While ever this supply is on, the VMAC regards it as a non-trigger condition and ignores it, and when it's turned off, with the lights off, the VMAC has no power to say anything at all. But when the parking lights supply is on, it can also power the VMAC board via its diode; if the ignition/accessories rail is turned off now, it triggers that input and its associated 'Lights still on, twit!' message will play — admittedly accompanied by any other messages caused by the absence of the ignition/accessories supply!

Unless you really want to be told more than once (especially in front of passengers) that you 'goofed', leave the repeat switch for the lights reminder warning OFF!

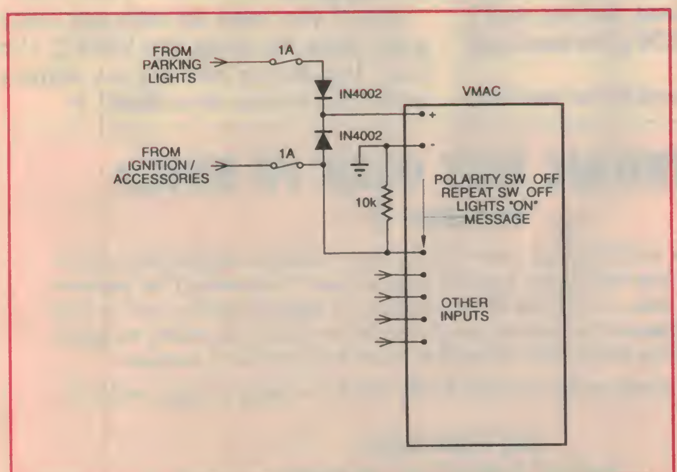
As with all car electrical modifications, you must be careful not to damage the existing wiring/connections, or to create any kind of fire hazard. So insulate the diodes with heatshrink tubing, and don't omit to install the 1A line fuses! The 10k resistor (to positively 'pull down' the ignition/accessories rail) could be situated on the VMAC's terminal block, or between the appropriate PCB pins.

'Borrowing' a speaker

In some situations it might be possible to make use of an existing speaker, instead of installing a new one just for the VMAC's messages. Perhaps a 'VMAC doorbell' could use one speaker of a stereo system, or a VMAC in industry could 'borrow' a local PA system speaker to make its announcements in one specific area.

This may be a job for the optional on-board relay and Fig.10's circuit, but first you have to be certain that the 'ground' of your VMAC board and its inputs is the same as the 'ground' of the audio system you want to break into!

Note that on many car audio sys-



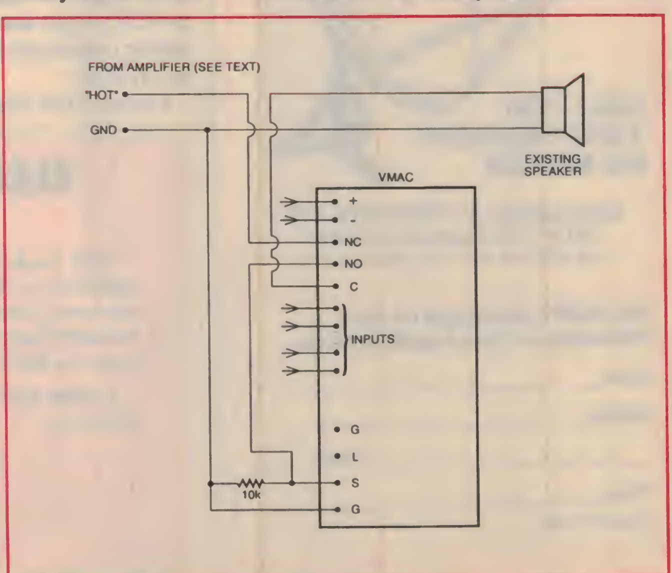


Fig.9 (above): How to wire the VMAC as a 'lights on' reminder for your car. Fig.10 (right): Using the relay to allow the VMAC to share an existing speaker.

Putting the VMAC Recorder to Work

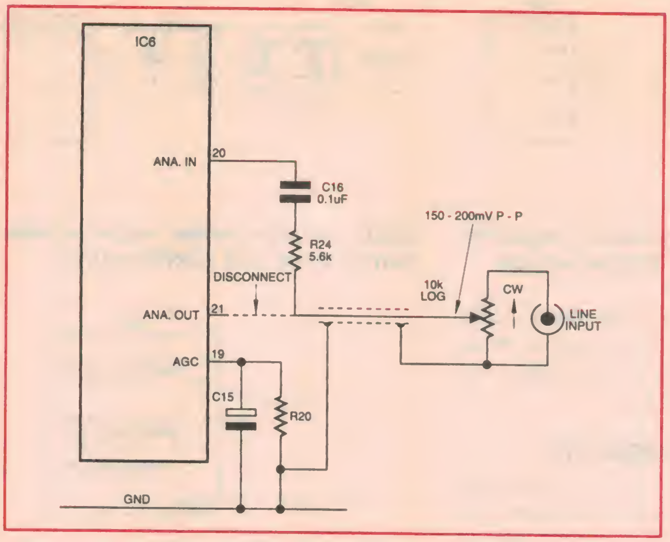


Fig.11: How to fit an external line-level audio recording input to the VMAC.

tems both of each speaker's leads are driven, and a ground to either will destroy one output stage. The same goes for a few hifi amplifiers — so if you're not absolutely sure of what you're doing, it's safer to install a separate speaker for the VMAC!

By the way, the 10k resistor in Fig.10 keeps C22 charged, preventing speaker clicks when the relay operates.

External line input

For those who are feeling adventurous, an external line-level audio signal can be fed into the VMAC for recording in lieu of the normal microphone, by using the circuit in Fig.11.

First carefully tin the right-hand lead of R20 on the top of the board, then unsolder R24's left-hand lead and lift it up from the board. Now solder the shield of a length of thin audio coaxial cable to R20's right-hand lead, and the coax's centre conductor to R24's left-hand lead in 'mid air'.

Connect the other end of the coax to a 10k logarithmic pot as shown, and feed your external signal into it. If you have an oscilloscope, adjust the pot for a level of 150 - 200mV peak to peak (about 50 - 70mV RMS) on its wiper. Otherwise make a few test recordings and set the level to a point a bit below where distortion on playback becomes noticeable.

Note that there is no automatic gain control when you're feeding a signal into IC6's 'Analog In' pin, in this way...

Conclusion

I hope some of these little circuit ideas are of use to you as they are, or at least provide a starting point for other VMAC applications you might think of.

In the coming months, I hope to find time to develop a few complete simple projects to allow the VMAC to comment on other 'real-world' conditions, so 'stay tuned'.

And if you come up with any really good ideas for using the VMAC, I'm sure Jim Rowe and his *EA* readers would like to hear about them! ❖

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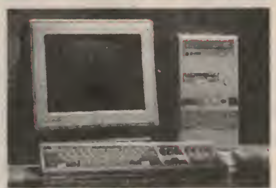

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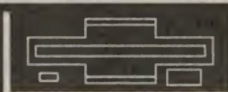

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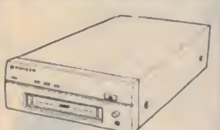

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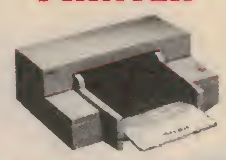

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READER INFO NO. 17

Experimenting with Electronics

by PETER PHILLIPS

An easy to build AM radio

Here's a simple experimenter's project for radio enthusiasts, either young or old. It's an easy to build, inexpensive AM radio that gives an excellent performance. And building a radio yourself is much more fun than just buying one over the counter, as any old timer will tell you!

We often get letters from older readers, lamenting that technology advances have robbed today's hobbyists of the fun of building a radio. True, the days of the cat's whisker detector and the crystal radio are gone. Enthusiasts today look for something more in a radio, as even the cheapest, crummiest AM radio you can buy outperforms a crystal set.

Another problem is cost. Only the truly dedicated are prepared to pay more, to buy all the parts for a build-it-yourself radio.

But somehow the appeal lives on, and in recent years *EA* has presented quite a few designs for radios. For example, there's an AM/FM portable radio project in the November/December 1993 issues. When Peter Murtagh ran this column, he described a basic regenerative AM receiver in May 1993, followed in August by a short-wave AM receiver. So why another one?

Without commenting on the merits or shortcomings of previous designs, this new one does offer quite a few features. First is cost. You can either scrounge the bits yourself, or buy a complete kit for only $10.

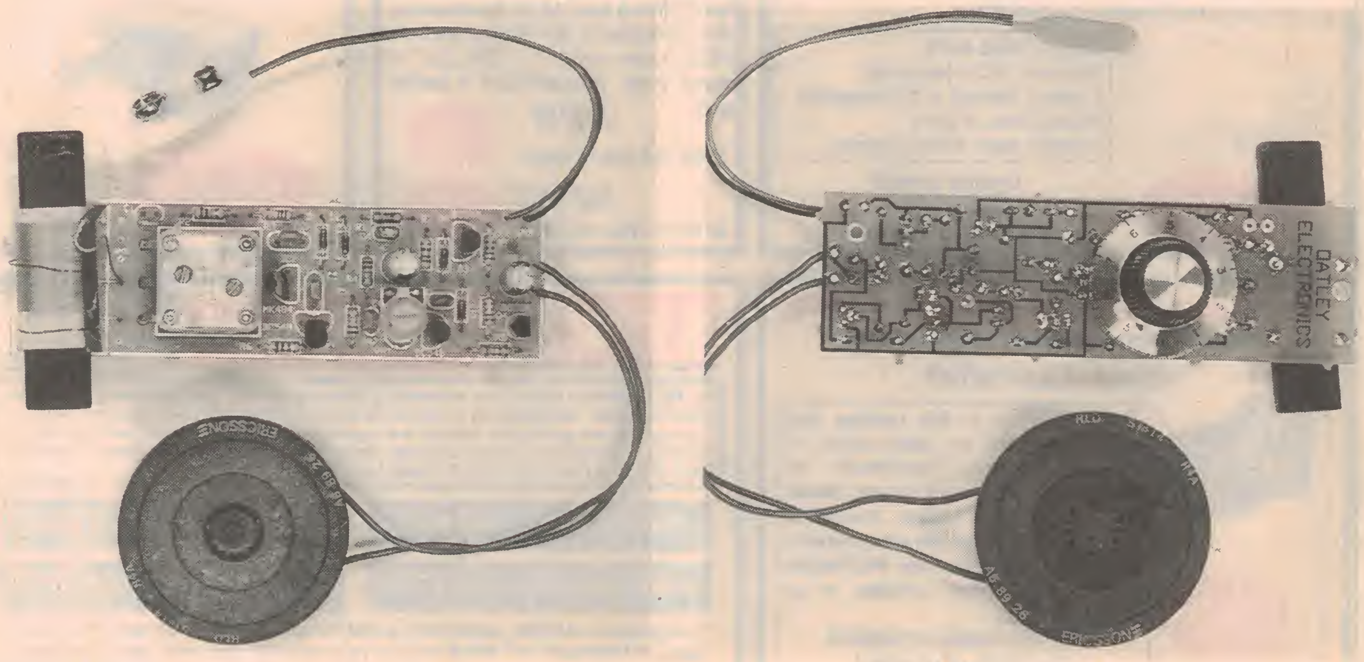
Next is performance. This simple design, based around a three-pin IC, has a good volume level, good selectivity and sensitivity, and it's portable. By the way, selectivity is the ability of a radio to receive a single station and to reject others. Sensitivity is a measure of the signal strength needed by the radio to produce a reasonable output level.

Finally, the construction of this project is very simple. Even if you've never built an electronic project before, you can build this one. You don't have to wind coils or fiddle with component placement — unless you want to, that is.

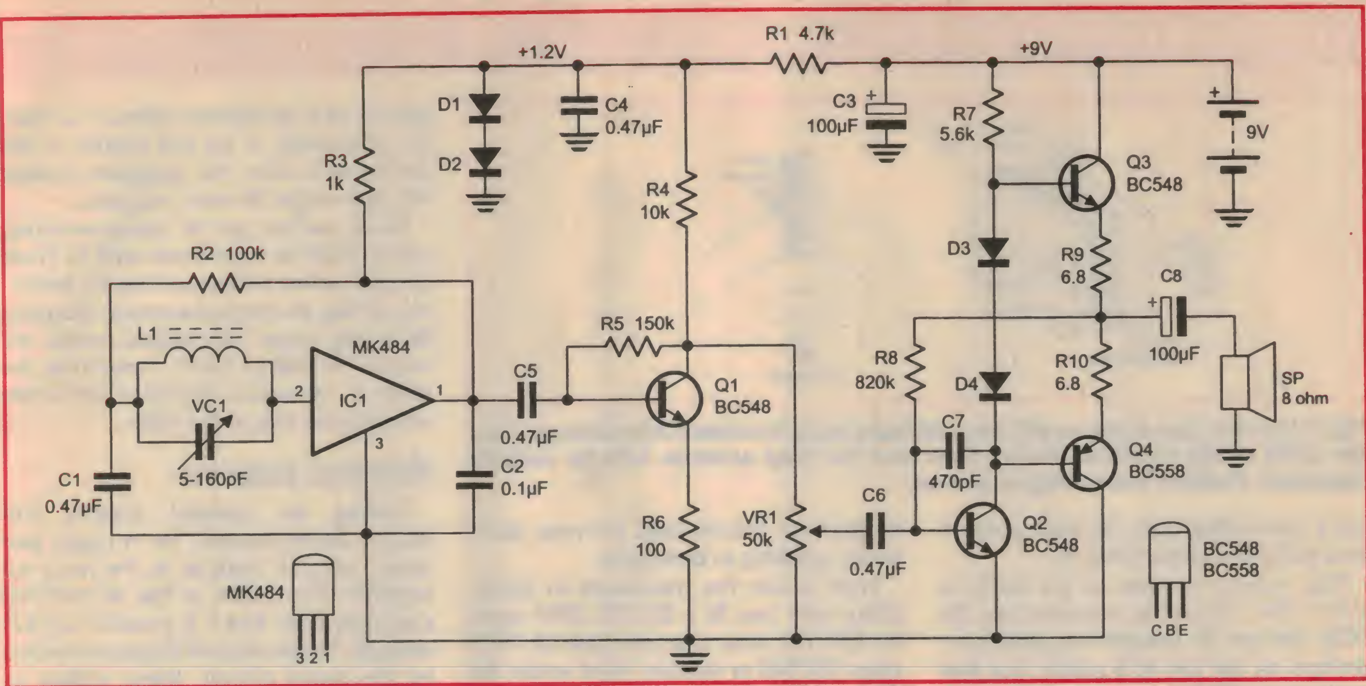
As you'll see, the design is also flexible and along with other modifications you can make, the receiver can be tuned for reception outside the normal AM radio band.

The MK484 chip

The radio section is based around an MK484 IC, which is a version of the popular ZN414 TRF (tuned radio fre-



Left: This AM radio delivers good performance, yet a kit of parts costs around $10. Right: This photo shows the track side of the PCB and the tuning knob attached to the shaft of the variable capacitor. The volume controls can also be mounted on this side if you wish, to get both controls on the same side.



The heart of the radio is IC1, a 10-transistor TRF radio IC. The rest of the circuit is a simple audio amplifier to drive a small speaker. Earphones or an external amplifier can be connected to the circuit.

quency) radio IC. In fact, this IC is pin compatible with the ZN414. The ZN414 can also be used, providing it's installed the opposite way round to that shown on the layout diagram.

The MK484 contains a 10-transistor TRF circuit that includes an RF (radio frequency) amplifier, a detector and an automatic gain control (AGC) circuit. The IC operates from a DC voltage between 1.1 and 1.6V, and takes a current of about 0.5mA.

The IC has a frequency range of 150kHz to about 3MHz, and tuning is with the parallel tuned circuit of L1 (a prewound coil on a ferrite rod) and VC1. The audio output is from pin 1 of the IC.

TRF receivers

Virtually all commercial AM radios from about 1930 are superheterodyne (superhet) receivers. A superhet has a number of interconnected blocks including an RF tuning section to receive the signal, an oscillator/mixer and an intermediate frequency amplifier.

The oscillator/mixer section converts the incoming radio signal to a fixed frequency, called the intermediate frequency (IF). The IF stage then amplifies this signal. The audio component of the signal is then extracted by a detector stage, where it's amplified by an audio amplifier. While more complex, the superhet design gives a better overall performance than the TRF design it replaced.

In the days of valves, a TRF radio consisted of a number of heavily shielded valve amplifiers connected in series, with each amplifier tuned by individual tuning capacitors. Most TRF valve radios had two or more stages of RF amplification, so tuning in a radio station meant adjusting a number of separate controls.

If the TRF principle was discarded some 40 years ago, you might ask why the MK484 is a TRF radio and not a superhet. One reason is that it's complicated to build a superhet radio in an IC, because of the need for quite a few external tuned circuits. Another is that there's a significant difference in performance between a TRF amplifier in an IC to that based around a valve.

By constructing an RF amplifier on a chip, there is very little stray capacitance to affect the operation of the circuit. There is also less noise generated by the circuit, so the amplifier can have a higher gain, which is easily achieved within an IC.

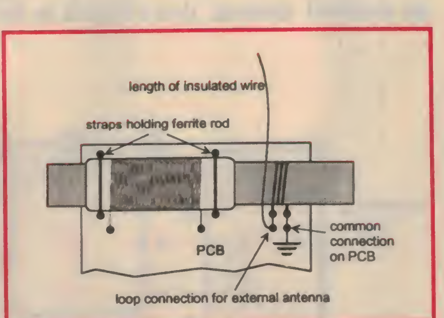


Fig.1: This diagram shows how to add an external antenna. Pads are provided on the PCB for terminating the antenna wire and the coil.

So the single-stage RF amplifier in the MK484 probably has at least the same performance as a two-stage valve RF amplifier. The selectivity of the radio is not as good as a superhet, and is determined mainly by the tuned circuit of L1 and VC1.

However, because it varies over the band, you can get a more uniform selectivity by limiting the operating range of the tuned circuit. For example, if you never listen to AM radio stations below 800kHz, then it makes sense to adjust the tuning circuit so its lowest frequency is 800kHz, rather than 540kHz. The same applies to the upper end of the band.

The sensitivity of the radio is probably as good as most low cost, commercial superhets. In any case, we later describe a few ways of improving the sensitivity. So in summary, because the TRF amplifier is in an IC, the performance of this radio is quite respectable, even surprisingly so.

The circuit

We've discussed the radio section, now to the rest of the circuit. The MK484 requires a supply voltage of between 1.1 to 1.6V, and diodes D1 and D2 act as a voltage regulator to give about 1.2V from a 9V supply.

The output of the IC connects to the common emitter audio amplifier around Q1. This amplifier has a relatively high input impedance because of R6, but it

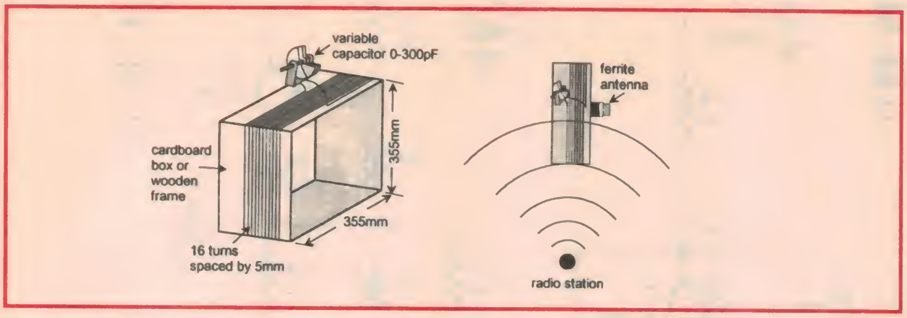


Fig.2: Use this loop antenna with any AM radio to pull in distant AM stations. Tune the radio to the required station, then tune the loop antenna with its variable capacitor. Position everything as shown.

has a low voltage gain. Its main purpose is to buffer the output from IC1.

The volume control of the radio is VR1. This control is mounted on the PCB, but can be mounted separately — perhaps on the top of a plastic box that contains the PCB.

The rest of the circuit is an audio power amplifier. This circuit has a simple complementary-symmetry output stage (Q3 and Q4), driven by the voltage amplifier around Q2. The output stage is biased to class AB operation by diodes D3 and D4.

The DC operating point of the amplifier is determined mainly by R8, which gives AC and DC negative feedback. Ideally, the voltage at the junction of R9 and R10 should be 4.5V (half the supply voltage). In practice, a small variation from this value won't unduly affect the operation of the output stage. Coupling capacitor C8 is needed to isolate this DC voltage from the speaker.

Building the radio

Everything apart from the 9V battery and the speaker mounts on the PCB. If you buy a kit from Oatley Electronics, you'll get a screen-printed board that shows the location of all the components.

Fit the resistors to the board first, followed by the capacitors and the diodes. The diodes and electrolytic capacitors must be fitted the right way round. The variable capacitor is held to the PCB with two screws. You'll notice that one connection of this capacitor doesn't go anywhere, as the unit has two variable sections but this circuit normally uses only one of them.

The ferrite rod and its coil are held in place with wire straps that solder to PCB pads either side of the rod. These straps should not form a complete turn, as this will affect the tuning. There are pads on the PCB for another coil (antenna coil), which we'll discuss later. For now, don't solder anything to these pads.

Now solder the transistors in place. Make sure you fit a BC558 (PNP type) for Q4. The other transistors are all NPN types (BC548 or similar). Next solder the IC in place, taking care not to apply too much heat to the IC during soldering.

Finally, connect the battery clip and the speaker. The speaker provided in the kit is from a telephone handset, and gives a surprisingly good sound, even without a baffle. Otherwise, a small eight-ohm speaker can be used.

Getting it going

If you've built the circuit from a kit, you should find the radio will work as soon as you connect a 9V battery to the circuit. If you have built the circuit from your own parts, you'll probably have to experiment with the tuning components. As a guide, the coil has around 90 turns on a ferrite rod measuring 12 x 55 x 5mm (W x L x D). The tuning capacitor is the same as those used in most commercial portable AM radios, and has a maximum capacitance of 160pF.

As with any radio, the reception will depend on the signal strength of the AM stations in your location. Unless you add an external antenna, don't expect to be able to pick up distant stations. As well, the orientation of the rod relative to the station will affect the reception. Rotate the radio to get the best reception.

Once you've got the radio working, you're ready to experiment with it. There are quite a few things you can do, including adding an external antenna, changing the tuning to get AM stations outside the normal broadcast band, connecting the radio to an audio amplifier, and even reducing the size of the radio.

External antenna

Adding an external antenna will pull in distant stations, but it might also cause several stations to be received together. The reason is that all received stations now have a greater signal strength. While most of these are rejected by the tuned circuit, those within its passband will be audible because the signal is now much stronger.

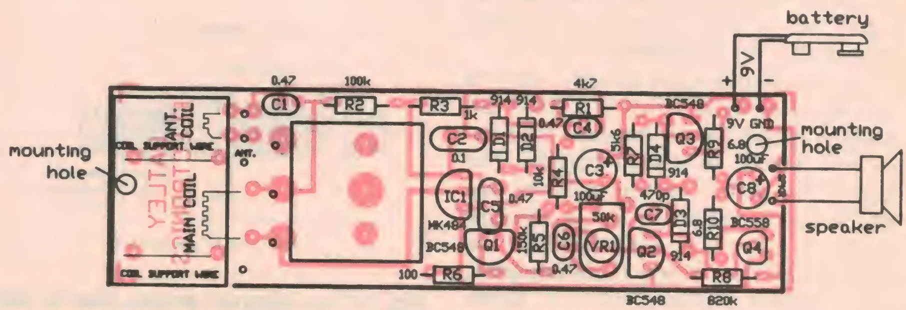
The illustration in Fig.1 shows how to add an external antenna. As the diagram shows, wrap two or three turns of insulated wire around the ferrite rod, terminated to the PCB pads provided. The pads closest to the right-hand side of the PCB are already connected to the common of the radio circuit.

The other two pads are floating, and one of these is used as a termination for the long-wire antenna. The length of the antenna wire is not critical, and can be many metres, possibly even strung up outside between two trees.

Loop antenna

Another way to improve the reception of distant stations, often without sacrificing selectivity, is shown in Fig.2. This method works with any AM radio and can give remarkable results, making distant stations quite audible that are otherwise buried in noise.

The dimensions shown in the diagram



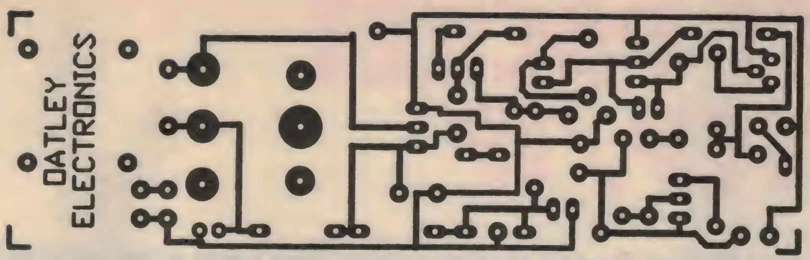
The ferrite road is held to the PCB with two wire straps that solder to pads on the PCB. The text explains how to add an external antenna. The tuning capacitor is held in place with two screws.

are not critical, and are those from our experiments.

You'll need about 23 metres of insulated wire (hookup wire is fine). Wind this wire around the perimeter of a 355 x 355mm cardboard, wood or plastic box (or framework). The size of the box is not critical, providing you wind all 23 metres of the wire around the box. The turns should be spaced about 5mm apart. Use silicone glue or tape to hold the turns firmly in place, and so they are lying flat on the box. This is important to prevent the inductance of the coil changing. Then connect a 300pF (or so) tuning capacitor (or old style variable capacitor) to the ends of the coil.

The aim is to get a tuned circuit that resonates at the frequency of the station you want to receive. The radio, already tuned to the required station, is placed so it's surrounded by the loop antenna, as shown in Fig.2. Then adjust the loop antenna's trimmer capacitor to tune the antenna to the frequency of the station you want to receive. The right setting is where the station you want comes in loudest and most clearly...

For best results, position the loop antenna so it's on a radius of the station's transmitter. In fact, you should be able to find a null when the antenna is exactly broadside to the signal, which is the principle of a simple radio direction finder. The radio's ferrite rod antenna should be at right angles to the loop antenna, so the coil wound on the ferrite rod is in the same plane as the loop antenna.



Here's the PCB pattern, for those who want to make their own board. Commercial use of this design is copyright to Oatley Electronics however.

LW or SW bands

To change the frequency band, either change the inductance of L1 or the capacitance of VC1. To receive frequencies below the normal (MW) band, *increase* the values of either L1 or VC1. For short-wave (SW), either of these values is *decreased*.

There are quite a few weather beacons that transmit on long wave (LW). For example, the weather beacon from Sydney International airport has a computerised voice that continuously broadcasts weather details.

Some universities transmit lectures on an AM frequency just above the normal MW band. Students usually have to hire a specially tuned radio to receive the broadcast. Other transmissions you might be able to pick up are ship's communications, some of which are around the 2MHz band.

Because the variable capacitor has two sections, these can be connected in parallel to increase the capacitance. Alternatively to decrease the capacitance, try connecting a 100pF (or lower) capacitor in series with VC1. To do this, lift one lead of VC1 from the PCB, and solder the extra capacitor in series with the lead and the PCB pad. Also adjust the trimmer capacitors on VC1 so they are fully opened (minimum capacitance).

There are several ways to change the inductance of the tuning coil. The first is to remove the MW coil from the ferrite rod and wind another with more, or less, turns. The less turns, the lower the inductance.

Another way is to add say 30 turns to the existing winding. The phasing of the extra winding will determine the inductance of the coil. That is, if the extra coil is connected so its windings are in the same direction as the existing coil, the inductance is increased. Reversing this winding reduces the inductance.

PARTS LIST

Resistors

All 1/4W, 5%:

R1	4.7k
R2	100k
R3	1k
R4	10k
R5	150k
R6	100 ohm
R7	5.6k
R8	820k
R9,10	6.8 ohm
VR1	50k PCB mount trimpot

Capacitors

C1,4-6	0.47uF monolithic
C2	0.1uF monolithic
C3,8	100uF/16V electrolytic
C7	470pF ceramic
VC1	tuning capacitor 160pF

Semiconductors

D1-4	1N4148/1N914 signal diode
Q1-3	BC548 NPN transistor
Q4	BC558 PNP transistor
IC1	MK484 radio IC

Miscellaneous

Silk-screened PCB, 105 x 31mm; ferrite rod and coil to suit; eight ohm speaker or equivalent; 9V battery and battery clip; knob for tuning capacitor.

A kit of parts for this project is available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.
Complete kit as shown in photos (excluding 9V battery)...................... $10
P&P $2.50

Connecting an audio amplifier

There are various ways to connect the radio to an audio amplifier. The simplest way is to replace the speaker with a fixed resistor (try a 22 ohm resistor) and to connect the input of the audio amplifier across this resistor.

Another way is to connect the amplifier to the collector of Q1, in series with a 0.47uF capacitor. The capacitor is needed to isolate the DC voltage at Q1 from the amplifier. In theory, this method gives the least distortion. Set VR1 to its minimum to stop the radio's own speaker from sounding.

Adding earphones

Anyone who is familiar with the Dick Tracy comic strip will know about watch radios. In fact, the ZN414 was probably developed to realise this fantasy, as watch radios were actually made in the mid 1980's. While you won't be able to fit this radio into a watch, it's size can be significantly reduced if you operate it with earphones. This also allows the radio to be operated from a single 1.5V AAA cell.

To do this, remove D1 and D2, and all the audio amplifier components to the right of VR1, except C6. Connect the battery positive to the junction of C4 and R4. The battery negative goes to the common rail. Then connect a small crystal or ceramic type earphone between C6 and the common ('ground') rail, perhaps using the base and emitter pads vacated by Q2. The volume control will still work as before.

Note that to use dynamic headphones (the most common type), you'll need to retain all the amplifier components and connect the headphones in place of the speaker.

So there it is, a neat little radio that brings back some of the old magic. Good listening! ❖

POCKET PACKET GOES TCP/IP

Tom Moffat's very low cost Pocket Packet modem project has been extremely popular since we published it a couple of years ago. Now he's worked out how to use it and your PC (or Mac) to run the same TCP/IP protocols used on the Internet — so you can now take advantage of those 'worm holes' between the packet radio network and the Net...

by TOM MOFFAT, VK7TM

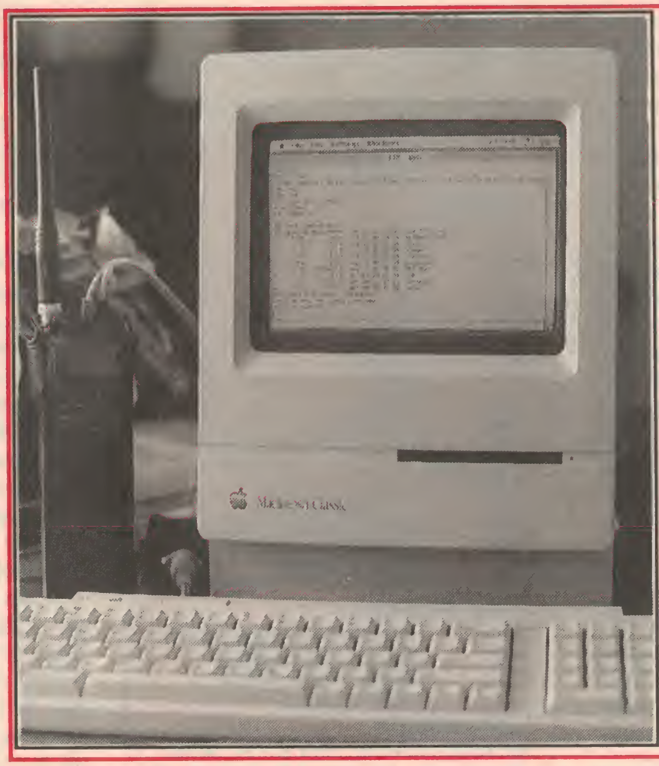
Packet radio has come a long way in the time since our original packet radio article in November 1992. Back then we tossed little 'packets' of data around among amateur radio stations, using a special protocol called AX.25. We could send messages to one another and read public messages posted on 'bulletin boards' run by enthusiasts. And in some cases it was even possible to download software.

In January 1993, *EA* described the Pocket Packet modem project, which let people get going on packet radio with a minimum of fuss. That was a very successful project, and hundreds of Pocket Packets were built and used all over the world. Now we've kicked the same Pocket Packet modem into modern times with some new software techniques. And there's even a Macintosh version!

We shouldn't be saying 'back then' when referring to AX.25, because it is still the most popular packet radio mode. But more advanced modes are now becoming available, spurred on by the Internet — which is really just a big packet network hooked together by wires, instead of radio. Now the Internet and the amateur packet network, and probably lots of other networks as well, are all merging into one giant web that's becoming known as 'The Information Highway'.

The new Pocket Packet enhancements to be described here will let you join in all this, again with a minimum of fuss, while maintaining full compatibility with the existing AX.25 system.

Ah, yes, the Information Highway. It's not all just hype, you know, despite all the babble you see on television and in the press. Try to visualise a road map of world-wide dimensions. The big fat red lines are the freeways interlinking major cities. The freeways are the Internet, and the cities are the Internet 'sites', repositories of information and ideas and programs and just about anything else that can be construed as 'knowledge'. Most Internet sites are currently associated with universities.



A Macintosh Classic running TCP/IP through the Pocket Packet modem and an Icom 2m handheld transceiver.

There are some thinner roads on the map too, the two-lane country roads that existed before anybody ever thought of freeways. These link smaller centres, or sites, with each other and with the bigger sites on the freeways. The smaller Internet sites might be businesses, or commercial Internet service providers, or even enthusiast groups such as APANA in Australia.

Within this context, the amateur packet radio networks are dirt roads back in the boonies. They are a little slow and bumpy, but you can still use them to get to the big city. The important thing is that an amateur radio station equipped with the right facilities, even if it lives on a goat track, is 'on the Internet'; it has its own identity and even its own Internet address, just like the big universities.

As this is being written there are a few legal questions surrounding direct connection between amateur stations and non-amateur Internet sites. The concern is mostly about users without amateur licences making their way onto amateur networks. This problem is being overcome at the moment by inserting amateur packets into the Internet via 'wormholes', from where they ride the Net to a wormhole in another country. They then emerge again as amateur packets, so this part of the system is available to licensed amateurs only.

Amateur 'Internet' sites come in different sizes and flavours. A station can be set up as a repository of information and software and a switching centre for electronic mail, although on a somewhat smaller scale than the universities. In this case it becomes a 'host' for other outlying stations, which become its 'users'. So the host is similar to a Bulletin Board station in the AX.25 world. Users are 'members' of the host.

User stations may have their own little mini-bulletin-boards or 'mailboxes' where messages may be left for that station or other users. The concept is similar to the PMS or Personal Message System under the AX.25 system. In fact the same 'mailbox' facility usually serves both AX.25 and Net users of the one station.

All this communication among Internet sites, large and small, takes place through a system called 'TCP/IP'. TCP means Transport Control Protocol, and as for IP, you guessed it — Internet Protocol.

Because of the Internet's academic background, TCP/IP has traditionally been implemented under the Unix operating system. Unix is regarded as an enormously powerful tool in the right hands, but mere mortals sometimes growl at its persnickity nature and its arcane command structure. Those of us who are gluttons for punishment sometimes see Unix as 'Real Computing' (you know, for real men...).

Seriously though, from a user's point of view Unix is a lot like MS-DOS, and one can learn to cope with it pretty quickly. The incentive is certainly there, since you can't really cruise the Information Highway at present without some basic Unix skills.

Most of what you do involves a 'dir' (or 'ls' in Unix) to look at a list of files, or 'cd' to change directories. Easy stuff. But it must come as a shock to Macintosh users, who find that their version of TCP/IP replaces the familiar mouse and icons with a command line that wants to talk Unix. It's a whole new adventure!

The TCP/IP software for the Mac and the IBM-PC may look and feel like Unix, but the programs are actually written in C for the 68000 or 80x86 processor.

Many of TCP/IP's major functions are written as separate sub-programs which must be explicitly enabled on each end of the link before they can work. So if you don't enable certain things, you end up with a simplified version of the software, and that's exactly what we've done with our Pocket Packet system. Enough is set up to allow you to get on air easily as a 'user'. But lurking in the background are other features you can enable later on, to turn your station into a major host site.

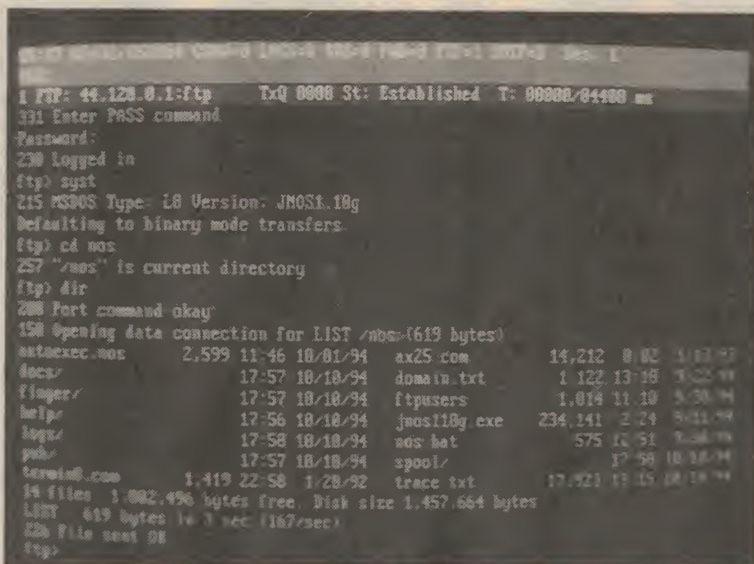
So what can TCP/IP do for you? Let's start with...

TELNET

The original purpose of TELNET is to let you log on as a user to a computer (host) on the other side of the world, just as though you were sitting in front of it yourself. You type TELNET <hostname> and after a short delay, you are greeted with the sign-on message from the distant computer.

Just think of the fun you could have with something like TELNET war_room.pentagon or TELNET launch_control.nasa. Thus a secret password is required before you can take control of the remote computer (unless you're a skilled hacker, of course, as in the book *Cyberpunk*).

In amateur packet radio TCP/IP, TELNET usually brings you into the remote computer's electronic mail (E-mail) system. Here, in theory at least, you can launch a message to any Internet address in the world (clinton@whitehouse.gov, for example) and expect a message back in return.



TCP/IP running on a 286AT computer with colour screen.

FTP

File Transport Protocol or 'FTP' is an extremely useful feature of TCP/IP, which allows you to log onto some remote computer and suck the brains out of its collection of shareware or public domain software. You enter the remote computer with the command **FTP <hostname>**, and the remote site will respond with a request for a user name and password. Most will accept 'anonymous' as the user name, followed by anything as a password. This is known, would you believe, as 'anonymous FTP'.

Once logged on, you will find a very DOS-like Unix directory structure through which you can move at will, drooling over flashy software that will soon be yours. When you see something you want, you use the command '**get <filename>**' and the file is slurped down the line into your own computer.

It is worth mentioning that the software on FTP sites is usually of world class, and sometimes much better than the commercial equivalents. The word processor I'm using at this very moment came to me via anonymous FTP. You should remember that the authors of these creations are entitled to some compensation for their work, so you should register the stuff you actually use.

FTP works exactly the same way over packet radio, although amateur sites won't be as comprehensive as the gold mines found at universities. Still, you can probably download the latest AX.25 and TCP/IP software releases, as well as heaps of text files that will further your TCP/IP education.

PING

This command tests the existence and quality of a desired path, before you try to use it for something serious such as downloading a big file via FTP. You type **PING <host-name>** and your computer shoots out a tentative inquiry, measuring the time it takes the remote computer to answer back (its PONG?). If the desired host doesn't respond (probably switched off), PING just sits there waiting forever. Real user-friendly, eh? Unix in full flight.

FINGER

This command puts the FINGER on somebody — tells who he/she is and what they're on about. You can type 'FINGER clinton@whitehouse.gov' and it will probably respond with something like, 'William Clinton, President of USA, wife name Hillary, address 1600 Pennsylvania Avenue, last logged on in 1938.'

Most of that information is put there by the user himself, in a 'finger file' on the remote computer. You can set it up to say just about anything you want; the finger file is a lot like the old 'brag tape' from amateur radioteletype days.

Pocket Packet

TTYLINK

This allows users to type back and forth to each other, keyboard to keyboard. 'TTYLINK <host-name>'. Good for typing practice?

CONNECT

This produces an old-style AX.25 connection with a packet radio station not yet equipped for TCP/IP. Once communication is established you can use Bulletin Board features in the usual way, and you can send out text from a file or capture incoming text. This is how I collect the latest weather satellite tracking data for Wesat decoders.

NOTE that there are some differences in syntax which may confuse users who are experienced with other packet programs: When issuing a connect (or 'c') command you must specify the interface your computer is to use, such as ax0 for the Pocket Packet modem. Also, when specifying digipeaters, do not use the word 'via' or 'v', just type the digipeater callsigns. For example: **c ax0 vk7tm vk7rit** will connect you to vk7tm through digipeater vk7rit.

One interesting feature of TCP/IP is that it can do most of this stuff at once. It's called 'running multiple sessions'. Your computer might be happily attending to one TELNET user when somebody else logs in as well. No problem! TCP/IP will juggle Session 1 with its left hand and Session 2 with its right hand, while possibly kicking off a mail transmission with its right foot.

If you get several stations on the one frequency handling several users simultaneously, there are going to be packets flying everywhere, fast and furious. Although the software tries to do the right thing and listen before transmitting, there are going to be the inevitable 'collisions' and lost packets. The software then tries again.

In the traditional AX.25 system the computer just keeps trying, blindly bleating out packets even if there is no response. TCP/IP on the other hand is a little more clever. If it doesn't get a response to an outgoing packet on the first try, it waits a few seconds and tries again. If this fails, it waits *twice as long as the first time* and then tries once again, hoping things have cleared a bit. This process continues as long as there is no response, but each attempt is delayed twice as long as the previous attempt.

This behaviour is known as 'exponential backoff'. If all the stations on the channel are also 'exponentially backing off' then the channel WILL become clearer, and eventually every message will get through.

Let's get technical

You may have noticed that all of this TCP/IP stuff refers to 'host names' and 'Internet addresses', but nowhere is there a proper amateur radio callsign. Isn't it illegal to transmit without a callsign? Well, that matter is taken care of automatically. You type in your callsign once, when setting up the TCP/IP configuration file, and never again. Yet the callsign appears in every transmission.

The truth of the matter is that everything that goes out of your TCP/IP site is wrapped in an AX.25 packet labelled with your callsign. As far as the AX.25 side of things is concerned, what's inside the packet is data — no more, no less.

But the 'data' is in fact an Internet packet, itself containing the Internet address it came from, the Internet address it's going to, and more data. And that 'more data' contains a third header, pertaining to all the gory details of Transport Control Protocol. Finally we get to the part of the message the end user sees, which might be just a few characters such as 'login:'

We'd better have a look at Internet addresses. They're based on a world-wide hierarchical system, meaning that you start with a big area and break it down into smaller areas. The general form of an Internet address is four decimal numbers, separated with periods (.) — aaa.bbb.ccc.ddd. The aaa part usually specifies a very large chunk of the world, perhaps a whole country.

In the case of amateur radio packet stations, ALL have the first number as 44. The second number then specifies the country, so in Australia amateur TCP/IP stations always start with 44.136.ccc.ddd. The ccc part would narrow it down to a particular area of Australia, and the ddd part would address a particular station within that area.

Internet addresses are assigned by a coordinator within your area, whom you can usually track down by making inquiries on the AX.25 amateur packet network.

You can't just make up an Internet address, except in the case of short-term testing for which the bbb.ccc code of 128.0 is assigned worldwide. So to have a fiddle around with TCP/IP pending the assignment of an official Internet address, you can use 44.128.0.ddd; the ddd number is your choice.

During the development of the Pocket Packet software I had two TCP/IP stations set up. One was running on my Toshiba notebook PC on my workbench downstairs, and the other was running on a Macintosh Classic computer on the dining room table upstairs. The computers communicated via two-metre amateur radios and Pocket Packet modems. I assigned 'test' Internet addresses to these computers: 44.128.0.1 for the PC, and 44.128.0.2 for the Mac.

Host names

Host NAMES also specify individual computers or 'sites', and are generally easier to remember than strings of numbers. I assigned some host names to the two computers above: ibmpc.ampr.org.au for the PC, and mac.ampr.org.au for the Macintosh. The 'ampr' part refers to AMateur Packet Radio. The 'org' part specifies an organisation, as opposed to others such as a commercial service (com) a university (edu) or government (gov). The 'au' part is Australia; if this country identifier is missing then the USA is assumed, since that's where it all started.

The first part of a host name is normally selected by the host owner; the 'wired' Internet site I use is called 'calvados', the name of the owner's favorite Greek wine. For amateur services the first part is almost always the station's callsign, so when I finally get my act together and get a proper Internet address assignment, I will also be known as vk7tm.ampr.org.au.

Individual users of a site then have their own identifiers, stuck on the front of the host name with an ampersand (@) acting as the glue. So, if I decide to let my son onto my system as a user, he will become 'steven@vk7tm.ampr.org.au'.

Note that lower case is important, since Unix discriminates between upper and lower case, unlike MS-DOS.

Another question arises: In all the TCP/IP usage examples above, we're only specifying user names and host computer names, such as TELNET war_room.pentagon. How does my computer here in Hobart know we want to access a computer in Washington DC? Well, in the first place my computer isn't sending out host names; instead it is shooting off packets with proper Internet addresses. This is possible because I have provided my version of the TCP/IP software with a file equating host names to Internet addresses.

I have manually created this file, for both the PC and the Mac, with the following information:

44.128.0.1 = ibmpc.ampr.org.au = ibmpc
44.128.0.2 = mac.ampr.org.au = mac

```
Mon Oct 10 13:08:17 1994 - ax0 recv:
AX25: VK7TM-QST UI pid=ARP
ARP: len 30 hwtype AX.25 prot IP op REQUEST
sender IPaddr 44.128.0.2 hwaddr VK7TM
target IPaddr 44.128.0.1 hwaddr

Mon Oct 10 13:08:17 1994 - ax0 sent:
AX25: VK7TM-VK7TM UI pid=ARP
ARP: len 30 hwtype AX.25 prot IP op REPLY
sender IPaddr 44.128.0.1 hwaddr VK7TM
target IPaddr 44.128.0.2 hwaddr VK7TM

Mon Oct 10 13:08:25 1994 - ax0 recv:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 44 44.128.0.2-44.128.0.1 ihl 20 ttl 14 prot TCP
TCP: 1001-23 Seq x11453bf0 SYN Wnd 432 MSS 216

Mon Oct 10 13:08:29 1994 - ax0 sent:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 78 44.128.0.1-44.128.0.2 ihl 20 ttl 254 prot TCP
TCP: 23-1001 Seq x12e28001 Ack x11453bf1 ACK PSH Wnd 2048 Data 38
0000 ..JNOS (ibmpc.ampr.org.au.)....login:

Mon Oct 10 13:08:37 1994 - ax0 recv:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 45 44.128.0.2-44.128.0.1 ihl 20 ttl 15 prot TCP
TCP: 1001-23 Seq x11453bf1 Ack x12e28027 ACK PSH Wnd 432 Data 5
0000 tom..

Mon Oct 10 13:08:37 1994 - ax0 sent:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 53 44.128.0.1-44.128.0.2 ihl 20 ttl 254 prot TCP
TCP: 23-1001 Seq x12e28027 Ack x11453bf6 ACK PSH Wnd 2048 Data 13
0000 Password: ...

Mon Oct 10 13:08:48 1994 - ax0 recv:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 49 44.128.0.2-44.128.0.1 ihl 20 ttl 15 prot TCP
TCP: 1001-23 Seq x11453bf6 Ack x12e28034 ACK PSH Wnd 432 Data 9
0000 ...bruno.

Mon Oct 10 13:08:59 1994 - ax0 sent:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 256 44.128.0.1-44.128.0.2 ihl 20 ttl 254 prot TCP
TCP: 23-1001 Seq x12e2803a Ack x11453c02 ACK Wnd 2048 Data 216
0000 ..[JNOS-1.10g-IHM$]....Welcome Tom,..to the ibmpc.ampr.org.au. T
0040 CP/IP Mailbox (JNOS 1.10g (8088))...Currently 1 user.....You hav
0080 e 0 messages...Area: tom Current msg# 0...?,A,B,C,CONV,D,E,F,H,I
00c0 ,IH,IP,J,K,L,M,N,NR,O,P,

Mon Oct 10 13:09:05 1994 - ax0 sent:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 62 44.128.0.1-44.128.0.2 ihl 20 ttl 254 prot TCP
TCP: 23-1001 Seq x12e28112 Ack x11453c02 ACK PSH Wnd 2048 Data 22
0000 PI,R,S,T,U,V,W,X,Z ..

(and a little while later...)

Mon Oct 10 13:09:25 1994 - ax0 recv:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 45 44.128.0.2-44.128.0.1 ihl 20 ttl 15 prot TCP
TCP: 1001-23 Seq x11453c05 Ack x12e28275 ACK PSH Wnd 432 Data 5
0000 bye..

Mon Oct 10 13:09:25 1994 - ax0 sent:
AX25: VK7TM-VK7TM UI pid=IP
IP: len 98 44.128.0.1-44.128.0.2 ihl 20 ttl 254 prot TCP
TCP: 23-1001 Seq x12e28275 Ack x11453c0a ACK PSH Wnd 2048 Data 58
0000 ..Thank you Tom,..for calling ibmpc.ampr.org.au. JNOS.....
```

Fig.1: A Telnet session on TCP/IP, as displayed using TRACE. It has been somewhat edited to make things clearer...

So if I give the command 'TELNET ibmpc.ampr.org.au', what actually gets sent out is 44.128.0.1. There's an even easier way; because ibmpc is also equated to 44.128.0.1, I can just type 'TELNET ibmpc' and the connection is made automatically. Should I try to connect with a host name that's not in the file, the computer complains about 'unknown host'. It is possible, of course, to use an Internet address directly, as in 'FTP 44.128.0.2'

Amateur TCP/IP software has a feature called TRACE which lets you keep track of incoming and outgoing packets, decoding them into a form which aids analysis of the communications process. It's a lot like the MONITOR feature in AX.25 programs. Watching TRACE is also a good way to learn how the system organizes packets within packets within packets.

Fig.1 is what TRACE saw, running on the IBM-PC, when the Macintosh logged into the PC for a TELNET session. Note that transmissions from both ends are labelled with VK7TM since they were coming from the same 'licensed premises'.

In the TRACE output, each packet is labelled with the time, so that's what we will use to refer to them. And in the interests of brevity we've deleted most 'housekeeping' packets and kept only the ones clearly illustrating how a connection works.

The exchange begins at 13:08:17 as the PC hears the Mac putting out a connect request to 'QST', meaning all stations within hearing range. What it's saying is 'I would like to connect with 44.128.0.1. Has anybody ever heard of it?'

The PC immediately responds with '44.128.0.1? Hey, that's me!' and the connection is established, between VK7TM and VK7TM. I thought the AX.25 side of things would throw a fit when it saw the same callsign as sender and receiver, but it didn't seem to mind...

Let's just break here for a moment. The first two packet displays show ARP being used, instead of TCP and IP. ARP is Address Resolution Protocol, the method by which the system figures out how to set up a path from point A to point B, given an Internet address. In our example ARP found its target on the first try, but to get a message across the world, things become a little more involved.

ARP is a science in itself, and part of the fascination of TCP/IP is learning how to handle ARP. The amateur TCP/IP software allows for the manipulation of ARP, but in the Pocket Packet implementation this lies dormant until the user gains more experience. Meanwhile, back at the ranch...

At **13:08:25** we have liftoff. A TCP/IP connection is established between 44.128.0.2 and 44.128.0.1. This event actually produces five exchanges between the two stations as they negotiate the technicalities of the connection, most of which we have deleted.

13:08:29. We see our first sign of user data,thestuff that is to appear on the Mac's screen. This appears in the line starting

Pocket Packet

with 0000 at the bottom of the packet: '..JNOS (ibmpc.ampr.org.au.)....login:'

13:08:37. I type my user name — tom — on the Macintosh keyboard and this is received in the 0000 line on the PC. It immediately responds with a demand for a password.

13:08:48. I type in the password, the name of my dog 'bruno'. Note that this 'secret' password has just become visible to anyone else on the channel who happens to be running TRACE. So beware!

13:08:59. We're in! The PC sends out a four-line burst of data: a welcome message to the TCP/IP mailbox, a no-mail-for-you message, and then a command-line with a list of options. There's too much command line for one packet, so after an acknowledgement, the PC sends the remainder.

13:09:25. Time to log off. I type 'bye' on the Mac keyboard. It was a short visit The PC immediately responds with a polite ta-ta message, and the session is over.

You should now have an idea of what TCP/IP can do, and what it looks like on air. This article is NOT intended as a comprehensive text on TCP/IP; it would take a whole book to do it justice. People in the know will say, "why didn't you mention SLIP, or SMTP?"

The reason is that there just isn't the physical space to cover all that stuff in one magazine article. However once you get a basic TCP/IP system up and running, you can use it to collect the heaps of TCP/IP information and documentation that are floating around on both AX.25 and TCP/IP networks.

Setting up TCP/IP with the Pocket Packet is now pretty easy, because a lot of effort was spent simplifying the software initialization files for both the PC and the Macintosh, so they are now (almost) at the 'plug and play' stage — at least as a 'user' station.

In fact you can see the TCP/IP software work immediately before you even construct the kit, by making your computer connect with itself. Type 'FTP ibmpc' if you use a PC, or 'FTP mac' if you use a Macintosh. Give 'anonymous' as a user name, any old thing as a password, and then type 'dir' to see the contents of the /pub directory...

Both disks know about the host names 'ibmpc.ampr.org.au' and 'mac.ampr-.org.au', and the Internet 'test' addresses they correspond to. You can use these as examples to enter more host names and Internet addresses in your own area.

Enter your details!

Within the 'autoexec' file you must enter your callsign, your own host name (probably <your-callsign>.ampr.org.au) and the official Internet address that is assigned to you. There is another file in which you store user names and passwords of stations you authorise to use your system. You also specify here the areas of your computer each user is allowed into, and the level or 'permission' they are granted. Tom-bruno is in this file as an example.

That leaves the 'finger' file, where you can (optionally) store information about your station and yourself, truthful or otherwise. There are many, many more things you can do later to soup up the system once you get some experience in TCP/IP, and the Pocket Packet initial implementation has been set up to make this as easy as possible.

Now to the kits: The Pocket Packet kit is unchanged from its first appearance in January 1993 *EA*. What we are doing is making a TCP/IP software disk available in addition to the 'SP' and 'Graphic Packet' software already on offer for AX.25 users. Remember that TCP/IP also runs AX.25, so it can take the place of the other disks. However, the TCP/IP software absolutely refuses to run on a slow XT computer.

The Pocket Packet kit is available from High-Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7054, for $89.00 posted in Australia, New Zealand, or the Pacific Islands (Zone 1). Remittance must be by cheque or money order in Australian dollars. We can supply additional software choices when ordered with the kits for $10 each, or we can offer existing Pocket Packet owners a TCP/IP upgrade for $20 posted. This offer only applies to kits originally purchased from High-Tech Tasmania.

Because the standard Pocket Packet kit requires a special hardware interface to make it work with the Mac, we published a special article on the Macintosh version in December 1994 *Electronics Australia*.

The Macintosh kit is supplied complete with the Mac interface for $99.00 posted. For PC owners who also have a Macintosh, we can supply a Mac software disk, along with the Mac interface kit, for $32.00 posted.

Two years ago the original Pocket Packet project launched a whole new crop of users onto the packet radio networks. Let's hope this latest effort sets off another influx into TCP/IP — especially in Tasmania. At the moment I've got no one to talk to except myself! ❖

A look into the effectiveness of

RECHARGING DRY CELLS

As part of the author's work in developing the dry cell charger described in the January issue, he spent considerable time and effort looking into the effectiveness of recharging dry cells, and how to get the most out the process. His results might surprise you...

PETER PHILLIPS

Dry cell recharging has been a hot topic for the news media in recent times, mainly due to the recent release of the Greencell dry cell regenerator. After all, as claimed by the ABC program *The Investigators*, the dry cell industry has a turnover of around a $300 million each year. That's a lot of batteries!

This program also ran a rather simple test to determine the effectiveness of the Greencell Regenerator. Their test used a 'drumming rabbit' that gave a 34-hour discharge time when fitted with new batteries. After recharging the batteries, the rabbit drummed on for only six hours, which is probably not enough to make most people rush out and buy the charger.

We will be publishing a review of this charger in a future issue of *EA*, but we can say now that the simple test run by *The Investigators* is neither definitive or conclusive.

The program also claimed that most consumer groups agree there is little chance of leakage or explosion when a dry cell is properly recharged, despite the warnings of this possibility printed on virtually every dry cell manufactured in the world.

We understand that *Choice* magazine will be publishing the results of its own tests on dry cell recharging, to be presented sometime in December '94 or January '95. At the time of writing, these results were not available.

The basic aim of our own tests was to find out how to get the most out of recharging a dry cell. There's quite a few unknowns in this, including finding the best voltage to discharge a dry cell to before recharging it, the effect of different values of discharge current and whether the size of the cell has any bearing.

In our tests we also examined the relative effectiveness of recharging a zinc-carbon cell compared to an alkaline cell. As well, we used two different charging systems, mainly to make our tests independent of the recharger; but it gave us data to compare the two systems.

Testing method

The basic testing process involved recording the time taken for a cell to discharge to a particular voltage when loaded with a fixed resistor. After recharging, the test was repeated.

We used two types of recharging methods. One type, denoted as '50Hz' in the tables, is a charging system based on a positively biased 50Hz AC charge current. The second charging system uses a 12kHz positively biased AC charge current. This type of charger is called an 'HF' charger in the tables.

To do these tests, we used a computer-based data logger, loaned for the purpose by Emona Instruments. We used four of the eight available inputs of the data logger, with up to four cells being discharged at the one time. The data logger was set to read and record the cell voltage every 10 or 15 minutes. Because we used two methods of recharging, matched cells were discharged and charged in pairs.

A problem we had to solve was the voltage drop, albeit small, across each connection in the discharge circuit. While a few millivolts is not a lot in a 6V or 9V system, it becomes significant when the cell voltage is 1.5V or less. To minimise voltage drops, the load resistor across each cell was soldered directly to the cell.

This was necessary as we found that if a cell was put into a battery clip, with the load resistor connected to the terminals of the battery clip, there was a

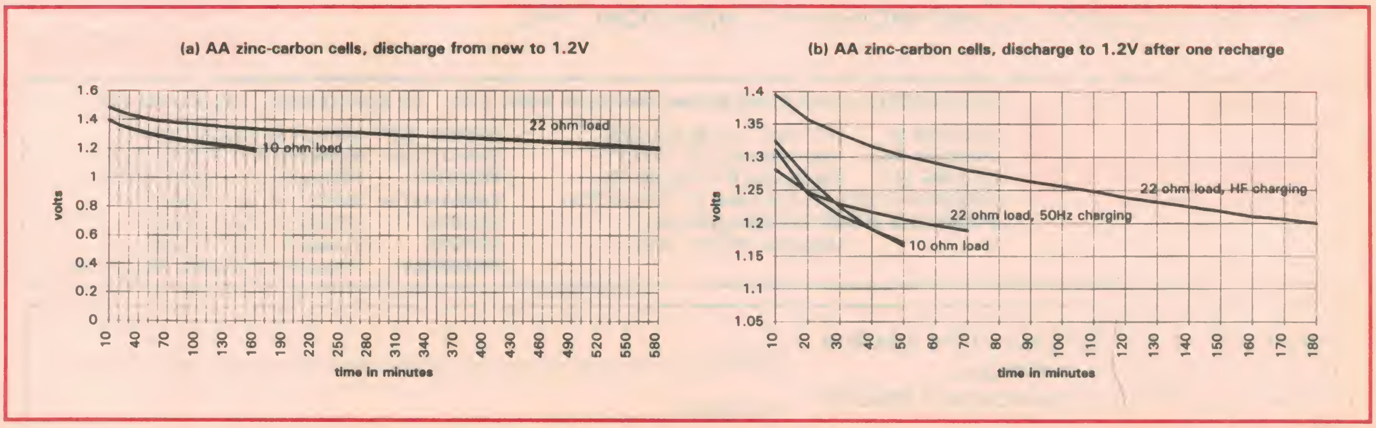


Fig.1: These graphs were produced with Excel 4.0, using the data captured by PicoLog. Notice in (a) that doubling the load resistance increased the discharge time by more than three times, to nearly 10 hours. In (b) the longest discharge time is three hours.

difference of up to 10% between the actual cell voltage and that measured across the load. This was despite using new battery clips, purchased for the purpose.

As we've already mentioned, two recharging systems were used, one using a biased 50Hz, the other a biased high frequency. In the 50Hz system, the recharge time was around 16 hours, as set by a timer. In the biased HF AC system, the charge current is shut off when the cell voltage reaches a particular value. Because this arrangement sometimes proved unreliable, if the system had not done so itself, the charging process was manually stopped after 16 hours or so.

Now that we've explained how we went about these tests, here's what we found...

Type of cell

The only two types of cells we tested were alkaline and heavy- duty zinc-carbon, and then only in AA sizes. The graphs in Fig.1 show in (a) four new AA zinc-carbon cells discharging to 1.2V. Two cells (Eveready) have a 10 ohm load, and the others (Rayovac) a 22 ohm load.

The cells with the 10 ohm load reached 1.2V after about 2.5 hours, and those with the 22 ohm load took around 10 hours. These cells are numbered as 1, 2, 3 and 4 in Table 1.

The cells were then recharged, two in the 50Hz charger, the other two in the HF charger. After reconnection to their respective loads, the cells loaded with 10 ohms took about 30 minutes to reach 1.2V. For those loaded with a 22 ohm resistor, the cell charged in the 50Hz charger took about one hour to reach 1.2V, and the other, charged in the HF charger took much longer, at three hours. This is shown in graph (b) in Fig.1.

However, when the 22 ohm load test was repeated with two more Eveready zinc-carbon cells (5 and 6 in Table 1), different results were obtained. This time it took 15 hours to discharge the new cells to 1.2V. After recharging, (one cell in the 50Hz charger, the other in the HF charger), it took both cells 1.5 hours to discharge to 1.2V.

Table 1: Comparison of AA zinc-carbon and alkaline cells

cell no.	cell type	discharge to 1.2V from	load	time taken (hrs)	charger type
1 & 2	zinc-carbon	new	10Ω	2.5	
1	"	1st recharge	10Ω	0.5	50Hz
2	"	1st recharge	10Ω	0.5	HF
3 & 4	"	new	22Ω	10	
3	"	1st recharge	22Ω	1	50Hz
3	"	2nd recharge	22Ω	1.5	50Hz
4	"	1st recharge	22Ω	3	HF
4	"	2nd recharge	22Ω	2.3	HF
5 & 6	zinc-carbon	new	22Ω	15	
5	"	1st recharge	22Ω	1.5	50Hz
6	"	1st recharge	22Ω	1.5	HF
7 & 8	alkaline	new	10Ω	6	
7	"	1st recharge	10Ω	3.5	HF
9 & 10	"	new	22Ω	24	
9	"	1st recharge	22Ω	15	HF
9	"	2nd recharge	22Ω	6.5	HF
9	"	7th recharge	22Ω	1	HF
10	"	1st recharge	22Ω	15	50Hz
10	"	2nd recharge	22Ω	12.5	50Hz
10	"	7th recharge	22Ω	4	50Hz

Comparing these results with those obtained from AA size alkaline cells shows that these cells are a much better proposition than the zinc-carbon cells. You can see the results in Table 1, where cells 7 to 10 are alkaline cells given the same charge-discharge tests as the zinc-carbon cells.

However, notice for cells 9 and 10 (alkaline) that even after the seventh cycle, the discharge time is one hour for cell 9 (charged in the HF charger) and four hours for cell 10, which was charged in the 50Hz charger. Cells 3 and 4 (zinc-carbon) were cycled twice, and gave a discharge time far less than the second re-cycle of cells 9 and 10.

From these results, we conclude that alkaline cells are a far better proposition for recharging. As well, when the results are averaged, the type of charging system doesn't seem to greatly influence the results.

Terminal discharge voltage

A common theme throughout these tests is a degree of inconsistency, as evidenced when we set the terminal discharge voltage to 1V. The results are in Table 2, where you can see cells 11 to 14 didn't respond at all to a recharge, in either type of charger. We even tried another recharge cycle, in case we had made a mistake and not recharged them the first time.

However, cells 15 and 16 *did* respond to recharging. Again the 50Hz charging system gave better results, particularly on the second recharge-discharge cycle.

Table 2: Discharge to 1V (all AA alkaline cells)

cell no.	discharge to 1V from	load	time taken (hrs)	charger type
11 & 12	new	10Ω	16	
11	1st recharge	10Ω	0	50Hz
12	1st recharge	10Ω	0	HF
13 & 14	new	18Ω	31	
13	1st recharge	18Ω	0	50Hz
14	1st recharge	18Ω	0	HF
15 & 16	new	4.7Ω	6	
15	1st recharge	4.7Ω	2.5	50Hz
15	2nd recharge	4.7Ω	1.5	50Hz
16	1st recharge	4.7Ω	2	HF
16	2nd recharge	4.7Ω	0.25	HF

This test uses a range of loads, with the 10 and 18 ohm loads calculated to equal that imposed by a typical personal tape player. In most cases, a tape player will start slowing down when the battery voltage is around 1V, which is often the only indication you get that the batteries are running low.

However, it seems from these tests that running a cell down to 1V gives it little or no change of being effectively recharged, compared to a final discharge voltage of 1.2V.

The graphs in Fig.2 give some more insight into this. These curves are printed directly from *PicoLog*, and we've added some freehand annotation to show the time for a cell to discharge to 1.2V, 1.1V and 1V. These results show that discharging a cell to 1.1V rather than 1.2V extends the total discharge time by about 35% to 40%. However discharging a cell to 1V only extends by a further 20%.

While we haven't done tests

for a discharge voltage of 1.1V, it seems this might be the best point to recharge a cell. Certainly somewhere between 1.2V and 1.1V gives a useful recharge.

D cells

We ran two tests with D cells, although both tests are the same: a load of 4.7 ohms discharging to a cell voltage of 1.2V. We did the test twice as some of the results seemed inconsistent. However, the same results were more or less obtained the second time. The results are in Tables 3 and 4.

Notice in Table 3 that cell 18, after its fifth recharge, gave a discharge time longer than its discharge time from new. A possible explanation is that the discharge cycle was interrupted after five hours, to be resumed 15 hours later. This didn't affect cell 17, as its cycle was terminated at five hours.

This is borne out by the results in Table 5. As we've already said, cells were generally cycled in groups of four, and in this case cells 9 and 10 (AA cells) were grouped with cells 17 and 18. And as it turned out, for reasons that don't matter, discharge cycle five for cell 18 was done together with discharge cycle six for cell 10.

In Table 5, you can see that cell 10 gave a 15.5 hour discharge time, compared to its initial discharge time of 24 hours. Cell 9 only gave 1.75 hours, so its cycle was terminated long before five hours.

However, nice as this theory is, it can't be used to explain the results in Table 4, where both cells gave a longer discharge time after the fourth recharge compared to prior recharges.

So from the results in Tables 3, 4 and 5, it's difficult to determine whether cell size determines a cell's capacity to be recharged.

What we *can* say is that both AA and D cells can be consistently recharged to give useful discharge times. Informal tests with AAA and 9V alkaline cells suggest that these cells can also accept a charge that gives a useful extension to their life. Incidentally, all alkaline cells used in these tests were Duracel types.

Load current

The results in Table 1 for cells 7, 8, 9 and 10 show that doubling the load resistance (from 10 to 22 ohms) gives an overall longer life. For example, cell 7 (10 ohm load) after its first recharge gave a discharge time equal to about 58% of its discharge time from new. Cells 9 and 10, with a 22 ohm load, both gave a discharge time of about 67% of their initial discharge time. While not a large difference, it suggests that the lower the discharge current, the more effective the rechargingbecomes.

Type of charger

From these results you can see that for AA cells, the 50Hz system gave better results than the HF system. However, the HF system proved superior when recharging D cells. It's probable

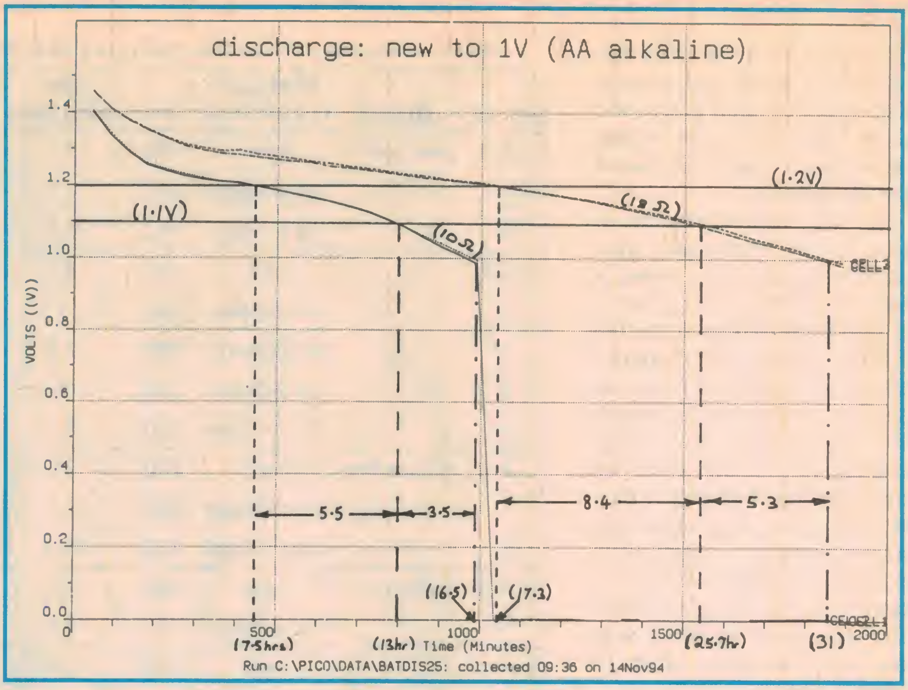


Fig.2: These annotated curves are printed directly from PicoLog and show new AA cells being discharged to 1V. As the added annotation shows, there's little to be gained by discharging a cell beyond 1.1V. The added times are in hours.

Table 3: Discharge to 1.2V, 4.7Ω load (D cells alkaline)

cell no.	discharge to 1.2V from	time taken (hrs)	charger type
17 & 18	new	17	
17	1st recharge	7.5	50Hz
17	2nd recharge	8.5	50Hz
17	3rd recharge	5	50Hz
17	4th recharge	4.75	50Hz
17	5th recharge	5	50Hz
17	6th recharge	4.5	50Hz
18	1st recharge	12.5	HF
18	2nd recharge	9.5	HF
18	3rd recharge	5.5	HF
18	4th recharge	7.75	HF
18	***5th recharge***	***19***	***HF***
18	6th recharge	7	HF

Table 4: Discharge to 1.2V, 4.7Ω load (D cells alkaline)

cell no.	discharge to 1.2V from	time taken (hrs)	charger type
19	new	20.5	
19	1st recharge	13	HF
19	2nd recharge	8.5	HF
19	3rd recharge	10	HF
19	***4th recharge***	***12***	***HF***
20	new	16	50Hz
20	1st recharge	10	50Hz
20	2nd recharge	5	50Hz
20	3rd recharge	4	50Hz
20	***4th recharge***	***10.33***	***50Hz***

Table 5: Discharge to 1.2V, 22Ω load (AA cells alkaline)

cell no.	discharge to 1.2V from	time taken (hrs)	charger type
9 & 10	new	24	
9	1st recharge	15	HF
9	2nd recharge	6.5	HF
9	3rd recharge	6.5	HF
9	4th recharge	4.5	HF
9	5th recharge	2	HF
9	6th recharge	1.75	HF
9	7th recharge	1	HF
10	1st recharge	15	50Hz
10	2nd recharge	12.5	50Hz
10	3rd recharge	9	50Hz
10	4th recharge	5	50Hz
10	5th recharge	4.25	50Hz
10	***6th recharge***	***15.5***	***50Hz***
10	7th recharge	4	50Hz

that increasing the D cell charge current of the 50Hz charger would bring the two systems more in line.

In fact, during the early stages of these tests, the 50Hz charger was giving substantially better results for AA cells than the HF charger. However, the charge current was obviously too high, as it caused the end of a cell to open, allow the cell to leak. The charge current was reduced to the value that gave the results shown here. We've had no further mishaps of this type since.

This shows another aspect of dry cell recharging: the result of too high a charge current. Despite manufacturer's warnings of possible explosions, it seems that the end of a dry cell is in fact a safety valve.

Conclusion

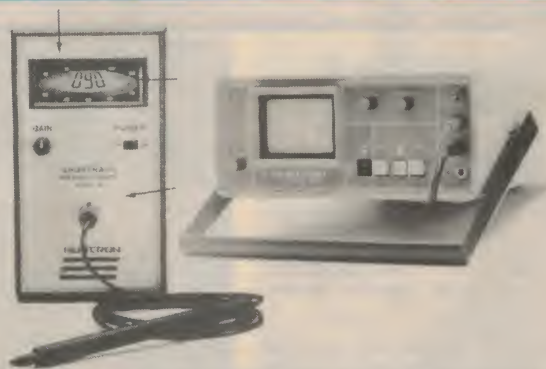
Our first and obvious conclusion is that recharging an alkaline dry cell is a worthwhile and cost-effective thing to do. Our tests haven't confirmed that the life of an alkaline dry cell can be extended by up to 10 times, as claimed by Greencell, but it's seems reasonable that given the right conditions, this claim could be proved.

It seems that the ideal voltage to stop using a cell and to recharge it is somewhere around 1.1 to 1.2V, and that better results will be obtained with lower discharge currents. As well, intermittent use will give improved performance.

In most of our tests, a cell was discharged within 24 hours of having been recharged. In some cases a week went by before a recharged cell was discharged, and we found little difference in the performance of the cell. However, it's likely that a recharged cell will loose its charge more quickly than a new cell. Therefore a recharged cell will probably give its best performance if put back into service as soon as it has been recharged.

Time has prevented us doing even more research, but these results give a pretty clear picture: recharging dry cells is an environmentally friendly and economically viable thing to do.

Our thanks to Emona Instruments for loaning the PicoLog data logger for these tests. We used the ADC-16 model, connected to serial port of a laptop computer. As you can see, the data can be exported, or graphs and tables can be generated directly by the Pico software. The ADC-16 is priced at around $300. For more information about the range of PicoLog data loggers, contact Emona Instruments, 86 Parramatta Road, Camperdown 2050; phone (02) 519 3933. ❖



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(See Aug '93)

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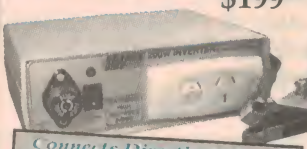

Connects Directly to Your 12V Car Battery & Gives You Instant 240V AC

(See SC Feb '94) This compact 200W Inverter can drive many mains power appliances including power tools, fluorescent and incandescent lights, TV's etc, using a 12V power source. It is ideal when camping, on building sites, on farms or as part of a solar power installation.

Features: • Small physical size • Very low standby current • Modified square wave output • Peak-peak voltage equal to mains sine wave • Low battery voltage shutdown • 30A - over current limiting • Fuse protection • Fully isolated output for safety • 2kg mass

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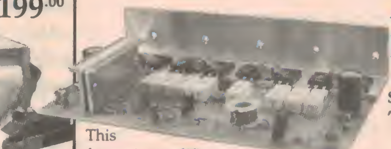
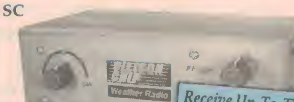


This fantastic amplifier will deliver a massive 350 watts RMS into 4 ohms. Using the latest mosfet technology and circuit design techniques this kit is supplied as a basic module, which makes it ideal to be built into sub-woofer enclosures, juke boxes and mixers etc. Housed in a suitable enclosure this kit will make a simple superb mono or stereo (using 2 modules) high power amplifier for discos,public address or even in the home if you are game enough to really rattle the floor boards!

AM Long-Wave Receiver Kit For Aircraft Weather Information

K 1115 **$34.95**

(See SC Sept '94)



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Receives up-to-the-minute weather and visibility information transmitted from weather beacons. These beacons located at airports transmit information for pilots. It receives on the Long-Wave band between 190kHz to 580kHz. Sensitivity of this receiver is very good. From Penrith in Sydney, it was able to pick up the beacon at Sydney's airport. Easy to construct. Requires 1 x 9 Volt battery (not supplied).

3 Spot Low Distortion Sinewave Oscillator Kit

NEW

(See SC December '94)

This fantastic sinewave oscillator features super low distortion and high output. It has three selectable frequencies and an output level control. Ideal for building and testing audio and speaker projects. 3 switch selectable frequencies at 100Hz, 1kHz and 10kHz. 2V RMS output, >0.004% distortion, Variable level output.

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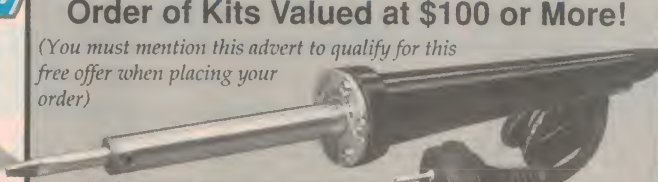


This famous *Micron* soldering iron features an efficient 25 watt element and tip. Reliable 240V AC mains operation. T 2415.

Multiple Announcement Digital Recorder Kit

NEW

(See EA Feb '95)

This kit is an extremely flexible microprocessor controlled eight channel digital voice recorder. Special circuitry requires no battery back up for memory. The circuit can generate a pleasant attention-getting 'chime' sound prior to each announcement, if desired. Includes an on-board 2 watt amplifier designed to drive a speaker. Total recording time 16 seconds.

K 9580 $109.00

Guitar Effects Kit

NEW

(See SC Feb '95)

This digital effects unit can produce a wide range of sound effects to enhance a musical instrument. It can be driven from a guitar or line source (or from both) and uses the latest in digital delay technology.

Features: • Echo, delay, reverberation and vibrato effects • Microprocessor controlled delay period and vibrato rate with a 2 digit display • Digital delay processing • Delay adjustable from 1-64 ms in 1ms steps • Vibrato rate adjustable from 1-10Hz in 0.5Hz and from 1-20Hz in 1Hz steps • User presets to select settings on power up • Input attenuator to prevent signal overload • Click free switching between effects in and effects out • No change in signal level between effects in and effects out

K 5538 $189.00

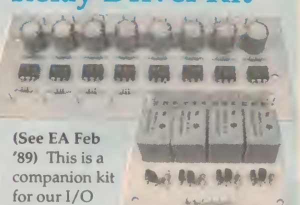
I/O Adaptor Kit for PC's

(See EA July '91)

Using this module you can computer control all kinds of things such as security systems, stage lighting, model railways, watering systems etc. The unit simply connects to a standard RS232C serial port on any PC. It has a 8 digital inputs controlling 8 outputs. A simple addressing systems allows multiple units to be "daisy chained" from a single RS232C port, expanding the number of inputs and outputs up to 64.

K 2850 $59.95

Input Buffer & Relay Driver Kit



(See EA Feb '89) This is a companion kit for our I/O Adaptor kit (K 2850). It has four relay outputs and eight opto-isolated inputs. This kit contains all parts necessary to construct both the input and output stages and even gives basic information on 240 volt triac controlling. As there is no professional software available for these items, a Qbasic program listing is supplied to help you complete your project.

Combined, the K 2850 & the K 2852 Allow You to Switch On and Off Appliances with Your Computer!

K 2852 $34.95

Infra-Red Remote Control Extender Kit

NEW

Control the Video in the Lounge Room From Your Bedroom!

(See SC April '94)

This kit will enable infra-red (IR) remote control of your VCR/CD etc from separate rooms. It works by receiving the infra-red signal from your remote control and then re-transmitting it to your VCR/CD etc. Ideal for watching the video on a second TV in a separate room.

K 5900 $49.95

M 9102 12V DC Plugpack to Suit **$11.95**

Crystal Tester Kit

(See SC August '94)

This simple oscillator circuit will tell you if a crystal is working or not via a LED indicator. Requires a 9V battery.

NEW

K 2528 $7.80

FREECALL 1-800 999 007 PERTH (09) 328 1599

Doc.JH113

Great Looking Quality Rack Cabinets for Your Hi-Fi or Pro Sound Gear

Professional Rack Frames and Panel Sets

As supplied to the industry Australia wide. Featuring an industrial strength black powder coat finish and made right here in Australia, they conform to international rack frame specifications. Ideal for use in professional audio installations, band gigs, computer patch panels etc.

Save Hundreds of Dollars on Similar Custom Made Rack Frames.
Supplied in Kit Form, Assembles in Minutes!

Cat. No.		Panel Space	Overall Height	Normally	This Month
H 5304	Rack Frame 4 Unit Black	178mm	280mm	$139.00	$97
H 5305	Side & Top Panels for H 5304			$49.00	$34
H 5306	Rack Frame 6 Unit Black	267mm	370mm	$149.00	$104
H 5307	Side & Top Panels for H 5306			$55.00	$38
H 5312	Rack Frame 12 Unit Black	533mm	635mm	$169.00	$118
H 5313	Side & Top Panels for H 5312			$89.00	$62

Save Over 30%

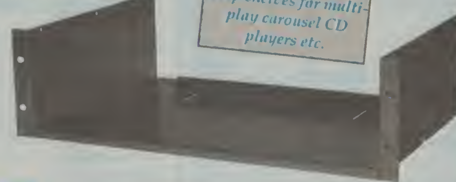
Suitable for home or commercial use, these fantastic rack frames are durable, strong, good looking and light weight. Supplied in Flat-Pack Form. Assembles in Minutes!

Racking Shelves

Installation of your CD, tuner, amp etc is a breeze with these handy rack shelves. Industrial strength black powder coat finish, includes special rear support to keep equipment in place.

Cat. No.		Depth	Useable Height	Normally	This Month
H 5352	2 Unit	340mm	76mm	$49.95	$34
H 5353	3 Unit	340mm	120mm	$54.95	$38
H 5363	3 Unit	400mm	120mm	$64.95	$45
H 5354	4 Unit	340mm	164mm	$59.95	$41
H 5364	4 Unit	400mm	164mm	$69.95	$48

Now available - extra deep shelves for multi-play carousel CD players etc.



International Standard Rack Cases

Overall depth 255mm. Mounting hole centres conform exactly to international racking specifications both vertically and horizontally.
Features: • Black or natural anodised finish • Aluminium construction with removable top and bottom steel cover panels • All dimensions conform to the International Standard • Ventilated lid • Deluxe finish front panel • Individually packaged • Supplied in Flat Pack Form - Easily assembled in minutes.

Save Over 20%

Cat No.	Unit Height	Height (mm)	Internal Height (mm)	Front Panel Finish	Normally	This Month
H 5021	1U	44	38	Natural Anodised	$77.95	$62
H 5022	2U	88	79	Natural Anodised	$92.50	$74
H 5023	3U	132	122	Natural Anodised	$99.95	$79
H 5031	1U	44	38	Black Anodised	$79.00	$63
H 5032	2U	88	79	Black Anodised	$95.50	$76
H 5033	3U	132	122	Black Anodised	$99.95	$79

Gives a Professional Finish to Any Project! Ideal for Building Amplifiers, Pre-Amps, Power Supplies etc.

High Power, High Performance 4"

This high quality and high power wide range driver is ideal for car sound etc. Heavy duty 8 ounce magnet. Maximum power rating is in excess of 30W RMS when used with a suitable enclosure. 8 ohm.

Save Over An Amazing 60%

C 0635 Normally $19^{.95}$ Each

Not Available from Altronic Dealers at This Price.

This Month Buy Two for Only $15 Pair

100mm High Performance Carbon Fibre Coaxial Speakers

As used in our famous *REDBACK* Monitor Speakers.
Constructed with a carbon fibre cone and barium ferrite magnet which results in a very high (25 watt) power handling capability.

Coupled with a Centrally Mounted Tweeter, the Overall Sound Quality is Excellent!!

Specifications:
Power: 25W
Impedance:.......8 Ohms
Freq Resp:.........90Hz-20kHz
Sensitivity:.......95dB 1W/.5m

C 0644 Normally $59^{.95}$ Each
This Month Only $30 Each,
or Buy 4 for $25 Each

Save Over 55% Great for Cars, Boats, Extension Speakers etc. etc.

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160VA rating. Two secondary windings, can be wired to give 70V at 2.3 amps, or 35V at 4.6 amps. Ideal for amplifiers, power supplies etc.

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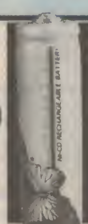
M 3070 Normally $65^{.00}$
This Month Only $39

Save 40% Only While Stocks Last



Premium Quality AA Nicad Battery

AA size. Top spec 500mA capacity. Great for those battery hungry toys, cassette players etc.

S 5107 Normally $13^{.80}$ Pack of 4
This Month Only $8 Pack of 4

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Protect Your One of Your Biggest Investments for a Mere $89

Features: • Remote control arming and disarming • Supplied with one key ring remote control • 125dB siren • Flashes headlights when activated • Flashing LED dash light when armed to deter would be thieves • Audible confirmation of arm/disarm • Can be wired to protect all doors, boot and bonnet
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S 5224 Additional Remote Control $29.95
S 5124 Optional 9V Battery Backup $17.75

Very Simple to Install
Requires Only Minimal Wiring

High Performance *REDBACK* Dual Cone 200mm, 8" Speaker

Amazing Offer! Over 50% Off. Strictly Limited - Only 100 Pairs Available at This Price

These speakers are the very same as used by contractors Australia wide in major background music and paging systems. They exhibit very high sensitivity due to the unique magnet and cone arrangement. Excellent for extension speakers for games rooms, patios etc.
Input Power: 15W max • **Impedance:** 8 ohm
• **Freq. Response:** 80Hz - 18kHz
• **C 2000** Normally $16^{.50}$ ea

This Month Buy 2 for the Price of 1
Only $15 Pair

C 0805 Slimline White Ceiling Grill to Suit $4^{.95}$

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AUTOMOTIVE ELECTRONICS

with **NICK de VRIES** MIAME, AMSAE.

Locally made hand-held engine analyser

This month we take a 'hands on' look at the new hand-held EM606 True Analog-Digital Engine Analyser, which has been fully designed and manufactured in Australia by Emona Instruments of Camperdown in NSW.

The popularity of hand-held test equipment has, over the years, been largely attributable to their relatively low cost compared with the alternative bench-top or free standing, capital intensive Tunescope console. Portability is also a factor when choosing this kind of low cost meter, and combined with rugged construction and durability, the appeal of the hand-held is its perceived versatility.

Many automobile manufacturers are insisting that their dealerships be equipped with their own brand of dedicated hand- held testers — well known examples being the GM Tech-One, the Ford CAM tester and the Mitsubishi MUT tester. The automotive multimeter, on the other hand, has to somehow bridge the gap between a dedicated tester and a full Tunescope.

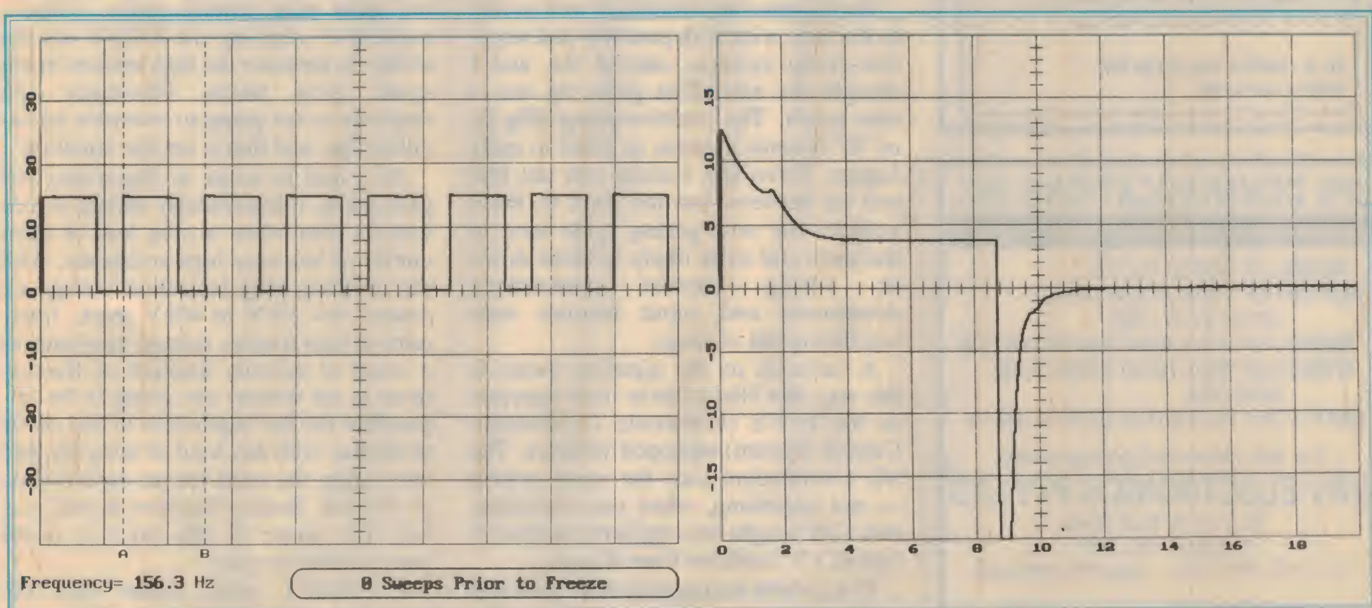
When *EA*'s Editor Jim Rowe referred Emona Instruments to me for an evaluation of their EM606 Engine Analyser, I was naturally pleased and somewhat curious to see what capabilities had been included. The accompanying brochure listed the EM606's 13 functions, which are: Ignition Coil Primary (peak voltage); Ignition Coil Secondary (peak voltage); Sensor Test; Fuel Injector Test; RPM; Dwell Angle; Duty Cycle; DC Volts; AC Volts; DC Amps; AC Amps; Frequency; and Ohms.

When I unpacked the meter, the Sensor Test caught my eye straight away, so I whipped open the bonnet of my VL Commodore and hooked up to a signal of a known amplitude and frequency. The Auxiliary Air Control Valve has a 15-volt rectangular wave on the ECU side of the device with a fixed frequency and variable duty cycle, as shown in Fig.1. The 'Pulse DC +18' range immediately displayed 15.12 volts, and I was hooked!

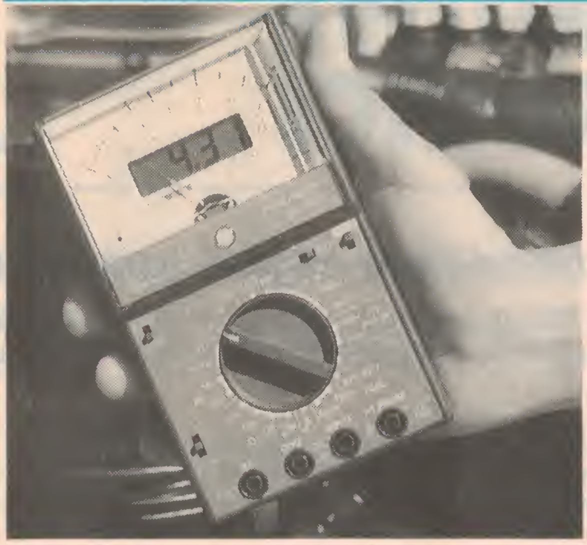
Most multimeters will show only the average voltage level in the circuit, based on the bandwidth of the meter — for example a Fluke 87 True RMS DMM shows 7.5V, depending on engine speed.

When I switched over to the 180Hz range, the frequency was displayed as 156.3Hz, spot on when checked against an oscilloscope and the Fluke. Zipping across to the Duty Cycle range, the reading varied between about 45 and 80%, in response to engine speed variations as a result of moving the throttle. So with a little switching back and forth, a reasonably comprehensive picture can be built up of the signal in question.

As with any piece of test equipment, it is important to know its limitations, and not too much faith should be put in the



Left: The 15 volt rectangular waveshape in question, showing the frequency at 156.3Hz. The ECU decreases the duty cycle as engine speed slows; this reading was taken at 'low cruise'. Right: The injector waveshape from a Mercedes 280 with 'D' Jetronic system, showing full load characteristics.



Emona's EM606 hand-held engine analyser provides both analog and digital display for a variety of useful engine parameter measurements. It is fully designed and manufactured in Australia.

readings obtained from a digital device when an oscilloscope would clearly be a better choice. The EM606 is a great little tester for breakdowns or when the shop's Tunescope is unavailable, but it's definitely not an alternative, and no self-respecting garage should be without some kind of diagnostic analyser.

Another essential feature in today's automotive multimeter is the ability to measure injector 'On Time', or Pulse Width. When all's said and done, the bottom line of the EFI system's calculations comes down to this: how long does it hold open the injector? So, it makes sense to start at the end of the equation rather than test each individual sensor first...

Here again the EM606 is well suited to the task, with both positive- and negative-going systems catered for, and I thought the extendible probe tip was a nice touch. The positive-going (Fig.2), or 'D' Jetronic systems as fitted to early Jaguar, Volvo and Lancia cars are few and far between; but the point is, these vehicles are now getting quite long in the tooth and more likely to break down as wiring harness connections deteriorate and input sensors start wandering out of range.

A variation on the injection theme is the way that Nissan drive their injectors in the ECCS (Electronic Combustion Control System) equipped vehicles. The VL Commodore uses the same system — not surprising, when you remember that GM bought the engine/transmission and ECCS complete from Nissan.

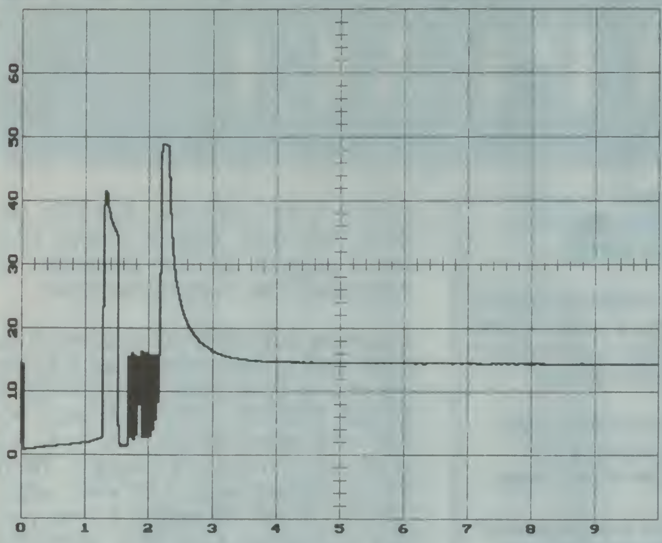
The EM606 manages to read even this rather hashy signal, although with some difficulty. When the throttle is snapped open and the pulse width changes rapidly, the reading does get a little confused — which is not really surprising when you see the waveform it has to deal with, in Fig.3. Fig.4 shows the regular 'L' Jetronic waveshape.

It was interesting to observe the response of the analog needle in the EM606 when connected to a varying voltage source. Having already bared the wire of my oxygen sensor on a previous occasion ('tsk-tsk', I hear you say), it was a simple matter of touching the positive probe to the centre wire. With the EM606 set to 1800mV I'm happy to report that the sensor's output is still able to swing between 0.1V and 1.1V in closed loop, indicating a healthy sensor.

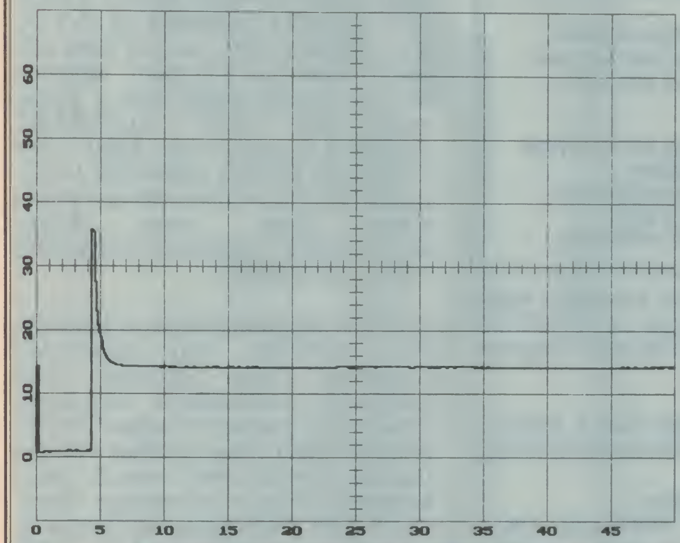
Another neat little inclusion in the kit of probes that come with the EM606 is the spark plug voltage probe. Using a capacitive coupling, the EM606 has the ability to measure the high tension in the spark plug wires. Obviously the response is not going to resemble an oscilloscope, and that is not the intention.

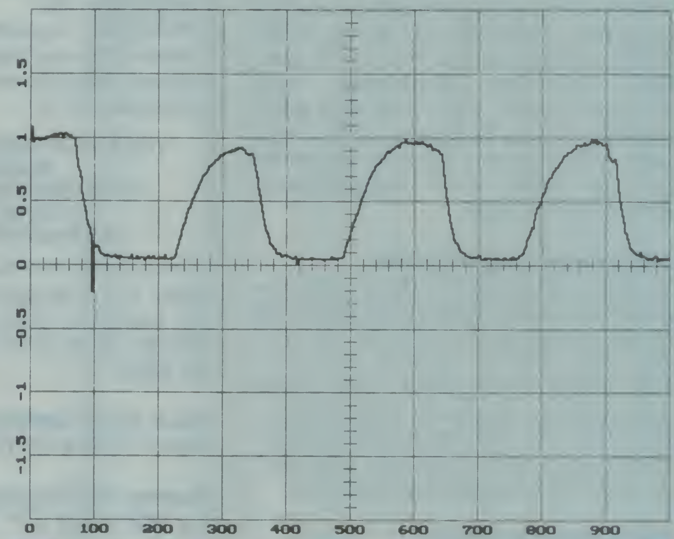
As a tool to assist in diagnosing engine faults, this particular feature comes into its own when a plug lead is open circuit or has very high resistance, with the resulting plug ionisation voltage up around the 20kV to 40kV mark. Intermittent high tension voltage transients as a result of mixture lean-out or fluctuations in air density are going to be impossible for the bandwidth of the meter to display with any kind of integrity, and here again the need for an oscilloscope is obvious. Such a function is well outside the scope of this kind of meter (sorry about the pun).

I couldn't quite figure out the relevance of the Coil Primary Peak Volts measurement. In a conventional points ignition system, the peak voltages are usually in the 120V to 220V range and



Top left: The ECCS waveshape from the author's VL Commodore. Note the initial 1.3ms pulse followed by a 41V spike; this part of the signal remains constant in all driving modes, including fuel 'shut off' during deceleration. Then follows the current limiting section and the final inductive spike at the turn-off point. Total 'on time' is 2.2ms.
Bottom left: A regular 'L' Jetronic system's injector solenoid valve waveshape, but with a limited back EMF kick of only 35V as fitted to the FORD XRB.
Below: The only way to test an Oxygen Sensor properly! Rapidly snap the throttle in quick succession; this checks both the range and response of the sensor. The EM606 copes well with this test, the analog needle following the O_2 sensor's output faithfully.





fluctuate quite rapidly — leaving the digital display struggling to keep up with the changing levels. There's certainly no way a moving-coil analog display can keep up, either!

When connected to my VL Commodore's coil primary terminal the reading sat reasonably steady at about 320V, although the actual level is 380V and varies only about 5V regardless of engine speed. As I raised the engine speed, the reading went up as well, but didn't reach 380V — leaving an impression that there may be a fault in the ignition system when the EM606 readings are taken in isolation.

A better use of the 900V peak range is also suggested in the user manual, and that is the measurement of the inductive spike in the injector circuit. At the end of each injection pulse there is an inductive spike of about 65V in most systems, and any reduction of this level may indicate a problem in the supply rail or switching transistors in the ECU. It is as well to note, however that some vehicle manufacturers have a voltage clamping circuit. For example, the XR8 Ford has only a 35V spike and when viewed on an oscilloscope, there is a noticeable plateau at its zenith indicating a limiting factor — presumably to protect the sensitive innards of the ECU. You may also have noticed in Fig.3 that the voltage is chopped off at about 49V, again with that characteristic plateau.

Other features of the EM606 include a tachometer function for both two- and four-stroke systems, dwell measurement, an audible continuity tester, four ohms ranges, a fused 18-amp current input and a hold function to freeze the displayed reading.

A quick squiz inside the meter (to have a look at the battery compartment, you understand) also revealed a beautifully laid out circuit board in a well organised case, showing every indication of a carefully designed and manufactured instrument.

In conclusion then, the EM606 Engine Analayser is a feature packed little meter, definitely worth the asking price of $599.00.

It is certainly very reassuring to see an Australian designed and made meter with so many features and innovations — proving once again that we can and do perform well when we compete in the marketplace against overseas products.

The EM606 comes complete with carry case, probe-type test leads (red and black), a chassis dog-clip with black lead, an HT clip-on probe with read lead, a fuel injector (MPFI and TBFI) probe with extendible back-probing tip, a battery and of course a user manual. It's available from Emona Instruments, 86 Parramatta Road, Camperdown 2050; phone (02) 519 3933, or fax (02) 550 1378. Emona also has offices in Melbourne, Brisbane and Perth. ❖

MARKETPLACE

FOR SALE

At Last!: A new book on Crystal Sets. "Crystal Sets 'N' Such" 150 fascinating pages. See "Book Review" EA Feb. '95. $19.95 Incl. P&P in Aust. R.J. Young - R.M.B. 1561. Benalla. Vic 3673.

AVO Valve characteristic meter MkII: $300 each, copy of manual $30 each. Ph: (AH) (03) 404 1744 Nick.

"The Homebuilt Dynamo": (construction plans), brushless electric generator, 1000 watt DC at 740 RPM. A$85 postpaid airmail from Al Forbes, Box 3919-EA, Auckland, New Zealand. Phone 0011 649 818 8967 anytime. Philips Ferroxdure rotor magnets (3700 gauss) kit now available cut to size and magnetised. Fax: 64 9 818 8890.

68705 Development System: In Circuit Simulator/Emulator and programmer board. Supports all 68HC705 range including C4, C8, J2, K1, P9, C9, D9, B5 & 68705 P3, U3, R3 micro controllers. For more information contact Oztechnics, PO Box 38, Illawong NSW 2234, Phone (02) 541 0310 Fax (02) 541 0734. Email oztec@ozemail.com.au

Digital Pulse Generator: Kits for this project ($95.00 + $4.00 p&p) as described in EA Dec 94/Jan 95 are available from Digital Logic Systems, PO Box 647, Elizabeth, SA 5112, Phone: (08) 255 2953.

Tiny Video Cameras: $10 off! This month from $189. Previous buyers get DOUBLE $20 off. **Matchbox Size PCB Modules:** from 32 x 32 x 23 with lens, C lens Mounts, Cases & Technical Manuals. See review pg. 138 EA Nov. '94. ALLTHINGS Ph/Fax 09 349 9413.

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Don's Short Form Kits: PIC16C54-58/71/84 Universal PCB $23, Basic Stamps $65, Serial Driven 18 I/O $70, Parallel Driven 64 I/O $38 RELAY8 PCB $10-$20, Z80 Dev. $38-$52, 8K-4MB Print Buff. $38-52. Promo Disk for all projects $2. Don Mckenzie, 29 Ellesmere Cres Tullamarine 3043.

Inverters 12V-240V 40 watt new fully built and tested units: See EA Aug '85 p64 for specs $40. NEW SWITCH-MODE POWER SUPPLIES input 90-132 VAC output 5V 7A, 12V 1.5A, -5V 0.1A use 2 in series? 2 for $15. NEW PLUG PACKS input 120 VAC output 12 VAC 0.75A 2M lead & 2.1mm plug use 2 in series 6 for $10. MOTORS NEW HIGH OUTPUT SMALL LIGHT TOP QUALITY GERMAN 18-30 VDC Max 500W (2/3hp) output 80% Eff. 4000-16000 rpm. 520 gram. 100mm x 54 mm. Double ended 6mm x 20mm shafts $50. CCTV EQUIPMENT Complete Cameras from $250. TINY PINHOLE VIDEO CAMERA MODULES 32 x 32 x 15mm will see thru a 2mm hole from $239. ALLTHINGS SALES & SERVICE Ph/Fax 09 349 9413

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CROs for Sale: Telequipment D43 (100mm dia. Dual gun long persistence CRT) Dual plugins, various types including spares, DC-20MHz. $350.
Telequipment D56 (120mm dia. Dual gun green trace) Dual time bases and crystal Marker, DC-15MHz. $250.
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All units are completely overhauled, calibrated and restored to as new condition, with service manuals and available spare parts.
Contact: Peter Harle (Liverpool NSW)

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Power Antenna controller for cars: Replaces switch in semi-automatic installations. Variable height, fully automatic action, built in delay. Small size no larger than the switch it replaces. Full built, easy to install . Details S.A.E please to Antenna Controller Box 31 PO Leichardt 2040.

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Schlumberger RF Communication Service monitor: model 4015 with Amps cellular and RS232 interface options under 12 months old, as new, $15,000. Phone 08 269 4744.

Valves: Vintage radio, TV, Audio & Industrial valves. All types stocked. New valves purchased. SSAE for catalogue. Electronic Valve & Tube Company PO Box 381 Chadstone Centre Vic 3148. Tel/Fax (03) 5711160 or (018) 557 380.

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Any early valve hifi, Quad, Leak Garrard 301/401, SME, Ortofon, KT66, KT88, 300B or similar. Cash paid 015 585 179.

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Low Rates. Contact Autronics on Phone (08) 294 8591.

THE CHALLIS REPORT

Continued from page 13

I soon discovered that Graham Humphries' choice of unusually low profile tyres may make the Senator more sure-footed, but it also modifies the normal soft Holden suspension to something nearer to what I was familiar with when I started driving 40 years ago. Every bump in the road was felt, and I regarded that as a better test of the CD Shuttle's operational characteristics than would be provided by conventional tyres.

Now both the CD Shuttle (and its associated VCR) were mounted in the boot, with the digital time and frequency processor. These were supplemented by a 'V12' four-channel amplifier and a neat purpose-designed low frequency vented speaker enclosure, installed just below the rear window shelf. As I discovered, the CD Shuttle didn't miss a beat, irrespective of how bad the bumps or potholes were. But what was even more impressive was the sensitivity and performance of the AM and FM tuners. Excluding some detectable very rapid short-term FM fades at the lowest point of the Emu Plains crossing of the Nepean River, both the AM and FM reception standards were impeccable.

My wife's comment was again most telling — "Why is this receiver so much better than mine?" I gently pointed out to her that the manufacturer had selected her car radio on the basis of price, not performance...

Summary

After a two day trip at distances of up to 120km from Sydney, I am most impressed by my observations and aural impressions. The Alpine TDA-7537A AM/FM cassette player and the associated CHA S607 CD Shuttle are unquestionably the best car audio system components I have yet tested.

This system has obviously not been designed for your 'average punter'. But following your win at the races, on the Lotto, or even following your elevation to a partnership in the firm, this should be your first choice for your new car audio system.

As I discovered with the music flowing freely, a car journey changes from a long and possibly tiring drag to a memorable and really pleasant experience. Viva Alpine Ai-Net!

Quoted RRP for the TDA-7537E AM/FM/Cassette Radio is $1099; for the CHA-S607 Six Disc CD Shuttle, $999; and for the ERA-G100 11 Band Equaliser/Sound Field Controller, $699. Further information on these and the other components in the Alpine Ai-Net range is available from Alpine Electronics of Australia, 6-8 Fiveways Boulevarde, Keysborough 3173 or 293 Princes Highway, Arncliffe 2205; phone (03) 769 0000 or (02) 597 1943, or fax (03) 769 0011 or (02) 597 1130. ❖

Vintage Radio

by PETER LANKSHEAR

A Quiz on vintage radio servicing

With the summer holiday season now over, vintage radio enthusiasts may be thinking about catching up on restoration projects. If your workshops are anything like mine, you'll no doubt want to reduce the size of the pile of receivers requiring attention. As your servicing skills may need to be sharpened, this month we have a 'warm up' quiz, based on actual faults that I have encountered.

Some of the following cases provide misleading clues, while others are commonly encountered. But hopefully the questions will provide a challenge, and the answers (given later — don't peek!) will prove helpful for future reference. Let's get going, then.

Q1: Stormy reception

First, a fault fortunately not so common today. The receiver came from a country district, remote from any transmitters. With it came the comment that, following a night of violent weather, reception was very weak and noisy. A brief test confirmed the that the set was very insensitive, but otherwise operation was normal. What did I expect to find?

Q2: Inversion puzzle

Again, the complaint was of poor receiver sensitivity. With the chassis out of the cabinet and up-ended, power was turned on for some voltage measurements to be made. However, performance was now normal; everything was in place, and a general check of voltages confirmed that there were no obvious malfunctions. Was this going to be an annoying intermittent fault?

There seemed to be nothing for it but to shift the receiver to one end of the bench and let it run until the fault showed up. However, immediately the chassis was again the right way up, sensitivity was again poor.

This strange behaviour was quite consistent. With the chassis inverted, sensitivity was normal; but as it was righted, the fault disappeared! Where would *you* look?

Q3: Very tidy owner...

A radio was brought in with a straightforward and common problem: completely silent from an open circuited output transformer primary winding. The owner was obviously a careful person, as the chassis was spotless. Rather than leaving the power cable dangling, he had meticulously wound it up and tucked it between the IF cans and the tuning capacitor.

Fig.1: A typical broadcast band interstage RF coil, showing the turn of wire used as a low cost top coupling capacitor.

The transformer was repaired, but although the set was obviously now alive, reception was nil. Idly twirling the spin drive, I found that reception returned above about 1300kHz. What was the problem?

Q4: Shocking experience!

One advantage of double-ended valves is the ease with which the control grids can be accessed. A very quick check for signs of life can be made by removing grid leads one at a time and putting a finger on the vacant grid cap. Starting with the audio stage and working forward one can often quickly get an idea which stage is dead.

(CAUTION! Do not attempt this trick with early English, European or type 807 valves. As more than one enthusiast has found, the cap on these valves is the anode connection, and the lead will have HT on it.)

In this instance, there was no reception from a receiver with a front end identical to that in the diagram. The finger test on the grid of the 6B6G diode/triode confirmed that the audio system was fine, and removal of the clip from the IF grid made a lot of healthy sounding noises. However, as I removed the grid clip of the 6A8G converter valve, I got an unpleasant surprise, and a test meter indicated full HT on the clip. How did the voltage get there?

Q5: Audio distortion

In a similar receiver, the faint sound that *was* audible was very distorted. A meter check showed that there was 40 volts at the 6F6G cathode. Initially, I expected to find that either the cathode bias resistor had gone high in value, or that the 0.01uF audio coupling capacitor had broken down, causing the 6F6G to draw excessive current. In fact, the coupling capacitor was good and I was surprised to find that the cathode resistor was completely open circuited. What had kept the valve operating?

Q6: Blue light area!

Receiver operation appeared to be normal, but with the rear of the cabinet in darkness, a bright *blue* glow fluctuating with the programme volume was visible on the surfaces of the mica spacers and envelope at the top of the pentode output valve. This can be seen in Fig.2; is it an indication of impending trouble?

Q7: Good looks, sour sound

A newly completed, large, and well made valve audio amplifier, laid out with meticulous symmetry, was not going at all well. Serious distortion was evident at even quite small outputs. Although operating voltages appeared correct, with valves, resistors and coupling capacitors all new, a test meter indicated one unusual condition. With no signal, there was a negative voltage on the grids of the cathode-biased output valves. What was happening?

Q8: Unsatisfactory repair

In order to retain the original appearance of the faulty IF transformer in Q2, a replacement winding assembly was taken from another transformer and fitted into the existing can.

The repaired transformer now tuned correctly, but the receiver's overall gain was significantly lower than it should have been. What had I done wrong?

Q9: Is it oscillating?

A receiver with a standard frequency-

Fig.2: A 47 type directly heated pentode displaying the blue glow referred to in Q6. Although giving the impression that the elements are overheated, the red glow in the mica spacer is simply a reflection of light from the filament.

converter stage was dead. It was suspected that the local oscillator was not operating properly, and the only test instrument available was an old 1000 ohms per volt moving coil multimeter. How could this be used to check the oscillator operation accurately?

Q10: Whistles

A small, inexpensive and well used superhet had developed an oscillation on all transmissions. Regardless of the frequency, with each signal, there was a loud whistle that varied in pitch with the tuning, indicating that the IF amplifier was oscillating. The cure was to add a component often omitted in economy receivers. What was it?

Q11: Frequency jumping

A dual wave receiver had an annoying habit of broadcast band signals suddenly jumping to a different frequency. These changes in frequency were always to the same dial settings. On shortwave, the set was quite stable. What was the problem?

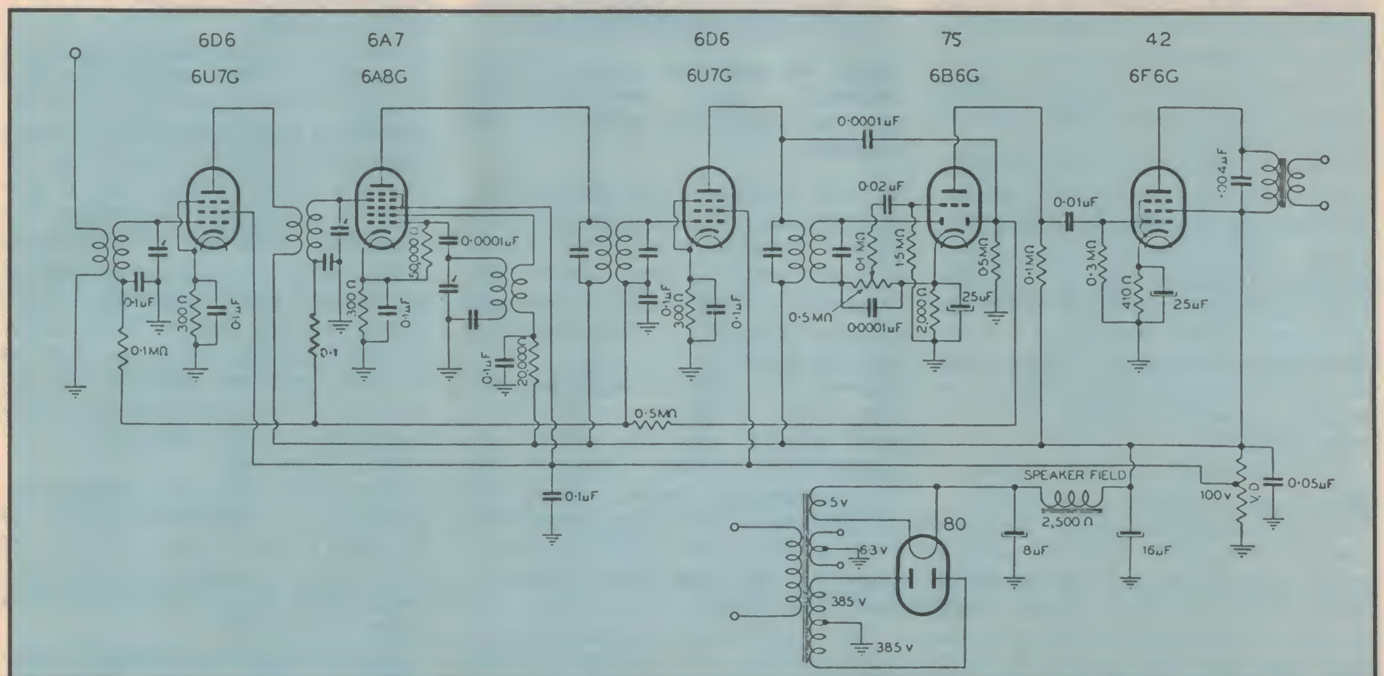
Q12: Fading sound

After a few minutes' operation, the sound from a five valve mantel set began to fade steadily, entirely disappearing after about 15 minutes. The finger-on-grid test mentioned in Q4 indicated that the fault lay in the audio system. This used type 75 and 6F6 valves in a circuit much like that shown in the diagram, except that the 75 had a small fixed bias applied to the cathode.

Both valves looked to be in practically new condition and this was confirmed by tests on an AVO model IV valve characteristic meter. However, voltage measurements provided a clue. Coincident with the fading, the voltage at the anode of the 75 steadily fell from 130 volts to 70 volts. What was happening?

The answers

Well, there you are. Twelve questions which I hope will have set you thinking, about servicing valve equipment. Now



This diagram comes from a 1938 'Technical Communication' published by Australasian Philips. It is not of any specific model, but is typical of a well designed receiver of the time, and demonstrates details referred to in the quiz.

let's look at the answers, so you can see how you went...

Answer 1: There were two related clues. As the receiver was situated a considerable distance from the nearest transmitters, there would have been an outside aerial, and there had been rough weather. A substantial voltage can be induced into a large aerial by lightning strikes in the neighbourhood, and in this instance, there had been sufficient energy to burn out the primary winding of the aerial transformer.

In the early days of radio, this was a frequent occurrence, and lightning arrestors and earthing switches were standard protective fittings. Today, fortunately, in most locations, with small lengths of wire indoors, loop aerials, or ferrite rods providing adequate reception, the incidence of this problem is much reduced.

Answer 2: The IF transformers were permeability tuned, with adjusting screws attached to ferrite slugs top and bottom. One of the upper slugs had become detached from its screw, allowing it to drop down the inside of the coil former, until it was stopped by the lower slug. With the chassis upside down, the slug slid back to its correct position.

Answer 3: Had the owner not been so tidy, the problem would not have occurred. In the stowing of the power cable, the rearmost moving vane of the tuning capacitor was pushed out of alignment and it shorted on to the adjacent stator. It was a simple matter to bend it back into shape.

To avoid troubles like this, when transporting sets always fully mesh the tuning capacitor.

Answer 4: The problem was a breakdown in the RF coupling coil, and can happen only in receivers with an RF stage. Coils with high impedance primaries frequently have a small coupling capacitor between the anode and grid connections. Many used a cheap substitute in the form of a single turn of wire, wound around the top of the smaller secondary winding as can be seen in Fig.1.

In many cases, this turn of wire is hard to see through a coating of wax. The only insulation is the silk and enamel covering the wire, and perhaps some wax or varnish. This can break down under the stress of the anode voltage, putting the full HT onto the grid lead and AGC line. The cure was simple. The wire capacitor was disconnected and a 5pF ceramic capacitor substituted.

This economy trick can also cause a puzzling loss of performance in a receiver. The insulation does not break down completely, but leakage puts a positive voltage on the grids connected to the AGC line. These grids mask the problem by acting as clamping diodes; but all the tuned circuits are heavily damped, desensitising the receiver.

Answer 5: The clue comes from the 40 volt reading. The cathode bypass capacitor was one of the traditional 25uF/40VW electrolytics. Apparently the valve acted as a high value resistor from the HT line, keeping the capacitor at its forming voltage; in the process, a small anode current flowed.

Answer 6: In fact, the glow showed that the valve was especially good. This phenomenon, known as fluorescence, occurs mainly in power output valves, and is an indication of a very hard vacuum. It should not be confused with the opposite problem, common in rectifiers, where there is an intense *lilac* coloured ionic discharge between the anode and cathode, caused by gas and often accompanied by loud raspy hum from the speaker.

Fig.3: For oscillator tracking, many receivers used semi-adjustable 'padder' capacitors similar to this example.

Answer 7: Amplifiers using push-pull high mutual conductance output valves, such as 6L6 and 2A3, were very prone to this problem. The cause was the symmetrical layout, giving the anode leads of the output valves the same length. These leads became a tuned line VHF tank circuit, to create a push-pull oscillator.

The remedy was to insert, close to the valve sockets, 10k stopping resistors into each output valve grid lead, and 100-ohm resistors into their anode leads. It was common practice to make layouts of audio amplifiers asymmetric, to reduce the possibility of these oscillations.

Answer 8: The connections to one of the windings had been reversed. The phase relationship of IF transformer windings is critical, and if incorrect, the inductive and unavoidable capacitive couplings between windings will oppose each other.

Answer 9: For a simple 'go/no-go' check, another receiver nearby could have picked up the oscillator; but this method does not give an indication of performance. It was no good attempting to use this type of meter to measure oscillator voltage, as they do not accurately indicate RF and in any event, loading is so great that touching a probe on the grid or anode pin is likely to have stopped the oscillator completely.

A simple and accurate method is to measure the oscillator *grid current* by disconnecting the COLD end of the grid leak resistor (in this instance a 50k resistor) at its junction with the 6A8 cathode, and inserting the meter set on the 1mA scale with the positive probe to the cathode. A typical reading will be in the order of 0.25mA, varying to some extent with the tuning.

Comprehensive valve data manuals published the desirable oscillator grid currents for converter valves. Too little, and gain will fall off seriously; whereas too much grid current indicates excessive oscillator activity that will cause spurious whistles.

Answer 10: As electrolytic capacitors age, although still adequate for hum filtering, they can develop a high impedance at high frequencies, severely impairing their effectiveness as RF bypasses. Good practice was to provide an additional capacitor, the equivalent component in the example circuit being the 0.05uF capacitor at the extreme right, bypassing the HT line. In economy designs, this capacitor was often omitted, giving the potential to create problems later. In this instance the oscillations were cured by bypassing the HT line with a 47nF (0.047uF) capacitor.

Answer 11: As the exact operating frequency of a superhet receiver is governed by the oscillator, and as the fault was not apparent on the shortwave range, either the broadcast coil or its padder was suspect.

Fig.3 shows the construction of a typical compression padder. There are several leaves, and each must be in good soldered contact. It is possible for one of

the leaves to miss out on soldering during assembly, and this happened in the receiver referred to in the question. Carefully resoldering the padder connections cured the problem.

Answer 12: My first suspicion was that the anode resistor of the 75 valve was going high as it warmed up. However, a rapid measurement showed that its value did not change, and in any event, even if it had doubled in value, the stage gain would not have changed significantly.

In fact, the problem was solved by replacing the type 75 valve. Substituting it in another receiver wired for a similar valve confirmed the fault.

Initially, there was a mystery in this case. Even prolonged operation in the valve tester did not indicate a significant alteration in the valve's characteristics, and there was no indication of gas. However with a 1.5 megohm resistor in series with the grid lead, a steady rise in anode current became apparent, and a meter in series with the grid lead provided an explanation. A strong and steadily increasing positive grid current was flowing, but with the standard valve checker setup where it was connected to a well regulated bias supply, the grid was firmly 'held down'.

This incident reaffirms the contention that blind faith should never be placed on valve testers. The final test of a valve is always operation in a receiver.

Well, there it is. I hope it was an interesting challenge. There are no prizes — but who knows, some of the solutions to these problems may be of help to you in the future. ❖

The Digital Printing Revolution

Contined from page 29

GLOSSARY

Imagesetter: A device used to expose digital information, via a laser, at high resolutions onto film, paper or plate material. Resolutions to 5000dpi (dots per inch) can be achieved, but levels of 1200dpi and 2400dpi are more common.

Moire: Moire pattern effects, visible as wave-like curves, are interference or 'beat' patterns often caused in printing by misalignment of the individual screens.

PostScript: Created initially by Adobe Systems in 1984, PostScript is a computer language designed to create page descriptions containing text, graphics and images. PostScript is device independent, meaning the final resolution of an image depends on the quality achievable by the output hardware. The same PostScript file will attain a 300dpi resolution level on a $1000 laser printer, then reach a level of 1200dpi or more on a $30,000 imagesetter.

Rosettes: Rosettes occur when all four colour printing screens effectively 'clump' together — usually caused by erratic mechanical action of the printing press.

Stochastic Printing: Stochastic printing is not a new technique, having been used for low resolution purposes, such as computer displays. Known as 'dithering', it is used to simulate full halftone by varying the density of uniform-sized printing dots, rather than the size of uniformly-spaced dots.

The process is also used by Sony's Sydney CD plant to imprint label data and images on compact discs.

is transferred to a rotating blanket and from there imprinted onto the paper by an impression cylinder.

After each rotation of the OPC the charge is cancelled, in readiness for the next colour. The paper is retained on the impression cylinder for multiple revolutions, one for each colour. A duplex function takes care of double sided printing, re-feeding the paper sheet onto the impression cylinder.

The trick to the whole device is the ink — which is actually liquid toner, of 2um particle size. The ink impression is heated while on the blanket cylinder and applied to the paper like a dry adhesive layer...

The E-Print machine can output 500 double sided, A3 colour impressions in one hour. Screen resolution is 133 lines per inch, at 800dpi. A later option will allow a complete publication to be printed, trimmed, collated, folded, stitched on the E-Print.

It's clear now that traditional printing will never be the same. ❖

RF Detector Probe

Continued from page 29

such as this, because just placing the probe on the circuit is enough to disturb things, changing the voltage at the measurement point.

This is particularly true at higher frequencies and higher impedance points in the circuit. So always try to measure the voltage at the lowest impedance point, such as a transistor emitter or FET source, rather than the collector (or drain) or the 'hot' end of a tuned circuit. This probe causes little perturbation to a circuit below about 200MHz when making a measurement in a 50-ohm system.

As can be seen from the frequency plot, the probe is useful to beyond 1GHz if allowance is made for the 40 - 50% rise and then fall in output between about 200MHz and 1GHz.

The second plot, shown Fig.4, indicates the degree of nonlinearity of the diode detector as it shows the DC output voltage against RF input level at a constant frequency of 20MHz. The slight 'turn over' at the top of the plot I don't think is real, because theoretically the graph should continue to rise linearly above about one volt RMS. The signal generator used for calibration had a maximum output just above one volt, so the rollover is more a characteristic of the measurement rather than the probe itself.

The HP 5082-2800 hot carrier diodes are rated at 70V PIV (reverse breakdown voltage). The probe can therefore handle up to 25 volts RMS. This is 12.5 watts or 41dBm in a 50-ohm system. The probe output voltage should follow the RF RMS input, volt for volt from 1 to 25 volts. Below 1V, the forward turn-on voltage of the diodes comes into play and less and less output proportionally is obtained as the RF input is reduced. At 100mV input (200uW or - 7dBm into 50 ohms), the DC output is only 25mV.

However that's what the calibration curve is for. You can make your reading of DC output and convert it to corrected RF input voltage, all the way down to 20mV (-14dBm) which is the threshold of the diodes starting to turn on.

So there it is; an RF detector probe which is useful from 20mV to 25V RMS, with a 67dB range and useable to beyond 1GHz. ❖

SHORTWAVE LISTENING

with
Arthur Cushen,

Radio Canada celebrates 50 years

It was in 1945 that the Canadian Broadcasting Corporation International Service, as it was then, commenced a shortwave service to Europe and the South Pacific. Over the years Radio Canada International or 'RCI', has become known as one of the major broadcasting organisations on the high frequency bands.

Earlier on Christmas Day 1944, experimental transmissions began on shortwave from Sackville in New Brunswick, to Europe. Then on February 25th, 1945 Canada's then Prime Minister Mackenzie King officially made the opening broadcast. The first aim of the service, to broadcast to Canadian forces overseas, grew rapidly to include, in the Prime Minister's words, "bringing Canada into closer contact with other countries."

RCI has for 50 years provided a window on Canada for other nations, and a link with home for expatriate Canadians. During those years, the service has expanded and contracted, languages have been added, others have been dropped, but the central role and the dedication to honesty and accuracy has continued unabated.

As the world has changed, RCI has adapted, with shortwave broadcasts still the mainstay. But there has also been an increasing amount of programming on other countries' domestic stations — in 24 cities in Russia, 15 cities in China, 11 countries in the former USSR and 15 in Latin America.

My own first reception reports went to Radio Canada on its opening, and this was followed by reports of various transmissions, including the first broadcast to the West Indies in April 1945, to South America and Mexico. By June, programmes were on the air for New Zealand and Australia.

It is interesting to recall that in a letter from Jack Acton (who was seconded from the BBC to commence the broadcasts from Montreal, written to me on April 18, 1946, he appointed me as technical monitor for CBC in New Zealand.

In 1972, the name of the station was changed to Radio Canada International and by that time the very popular Radio Canada Shortwave Club was established, with Basil Duke and Duncan Nicholson behind the microphone. So successful was this new venture that a monthly magazine was published and sent to contributors world wide.

Following the closure of this section of Radio Canada, Ian McFarland commenced 'Letterbox' which he hosted for 16 years. The highlight of this programme for me was the 40th anniversary of Radio Canada in 1986, when they sponsored the Association of North American Radio Clubs convention in Montreal, and invited me there as guest speaker.

This gathering enabled those broadcasters from many countries and shortwave listeners from various parts of the world to visit Radio Canada in its own home, Maison de Radio-Canada in Montreal.

A severe budget cut took place and went into effect on 22 March 1991 when the switch was pulled, to put Radio Canada off the air. Transmissions were quickly resumed following world wide protests, but specialised programmes for shortwave listeners were greatly reduced and RCI became a relay of the Domestic Service in many of its programme fields. Ian McFarland left RCI and went to work for Radio Japan for two years, but is now back in Montreal in a free-lance capacity.

The financial crisis at Radio Canada International continues and though many of the former programmes have been reinstated, RCI is still facing severe Government restrictions. However there have been many forward steps, including the use of relay bases in various countries which are shared on a reciprocal agreement. Radio Canada is using relay bases in Seoul, Korea; Skelton, UK; Moosbrunn, Austria; Sines, Portugal; Xian, China; and Yamata, Japan.

Transmissions to Australia and New Zealand ceased in the 1960s, after many years of evening transmissions to this area. We are now dependent on signals in the broadcasts to North America and Europe. These signals are monitored at my office on a daily basis and the best two transmissions are 0600 - 0630 Monday to Friday on 6050, 6150 and 11,905kHz and daily at 2100 - 2230 on 11,945 and 13,605kHz, which are among the best frequencies heard. The transmitters originally were of 50kW, but now Sackville houses five 250kW and three 100kW transmitters.

Radio Metropolis, Prague

A new shortwave commercial service from the Czech Republic is being broadcast world wide using the slogan 'Radio Metropolis', which has been a long established FM broadcaster in Prague. Using one of Radio Prague's transmitters, the station is operating on a 24 hour per day basis, and has been heard in several transmissions.

It is the first Czech private radio station with a world wide schedule broadcasting in English, Czech and Russian with the service defined as Europe, North Africa, the Middle East and North America. Broadcasts in English indicate that it is promoting the ideals of democracy, mutual understanding and free flow of information. They are planning to improve cultural and trade cooperation with other countries in Europe and a better understanding of life in the Czech Republic.

The present schedule is: 0700 - 0750UTC on 9455kHz; 0800 - 0855 on 5905; 0900 - 1055 on 9470; 1100 - 1255 on 5905; 1300 - 1455 on 5905; 1600 - 1755 on 5940; 1800 - 1955 on 7250; 2000 - 2255 on 7305; and 2300 - 0100 on 6200kHz.

Reception reports are requested, with details concerning reception of the programme and listeners are offered prizes in the form of CD recordings and other mementos from Prague as reports received by the station take part in a lottery. In the South Pacific, the best reception has been in the transmission 1600 - 1755UTC when using 5940kHz. ❖

AROUND THE WORLD

ECUADOR: HJCB Quito, has English broadcasts 0030 - 0430 on 9745 and 12,005kHz, 0430 - 0500 on 12,005, 0500 - 0700 on 9745, and 0700 - 0830 on 6205 and 9420kHz, to North America and Europe. Broadcasts to the South Pacific are 0700 - 1030 on 6135 and 9745kHz and 1030 - 1130 on 6135kHz. A further service to Europe is at 1700 - 2000 on 15,490kHz. There is a 24 hour transmission on USB on 17,490 and 21,455kHz. 'DX Party Line' is broadcast for shortwave listeners on Saturday at 0737 and repeated at 1007UTC.

GUAM: KSDA Adventist World Radio has launched a new programme called 'Wave-Scan' on all AWR stations and some other broadcasts. The broadcast on KSDA is Saturday 1515 and Sunday 1500, both on 9370kHz and Sunday 2315 on 11,980kHz. The programme is compered by Adrian Peterson and is currently of 15 minutes' duration, but is expected to be extended to 30 minutes later.

INDIA: All India Radio, Shillong, according to verification gives a schedule on 4970kHz at 0030 - 0400 and 1100 - 1630UTC. The station originates programmes for the North Eastern Service.

JAPAN: Radio Aum Shinrikyo has been heard in English at 0430 - 0500 on 6000kHz. At 0500 Moscow chimes follow and then an English broadcast from the Voice of Russia World Service.

KOREA SOUTH: Seoul Domestic Service is heard in Korean on 13, 670kHz opening at 2200 with a short English announcement then in Korean. This is heavily jammed and jamming continues past 0900UTC.

SOMALI: Sweden, Radio Free Somali is testing at 1300UTC on 9865, 9900 and 9935kHz. It is operated by Sam Voron. This Australian started up Free Bouganville. His Australian address is Sam Voron, 2 Griffith Avenue, Roseville, NSW 2069, Australia. Sam Voron operates on 20 metres and was heard at 0300 on 14,275kHz. The transmitter is located outside Mogadishu.

USA: WINB, PO Box 88, Red Lion, P.A., is operating at 1700 - 1900 on 15,715kHz and 1900 - 2100 on 12,160, 2100 - 2400 on 11,915, 2400 - 0500 on 11,950kHz. ❖

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Daylight Time and 13 hours behind NZ Daylight Time.

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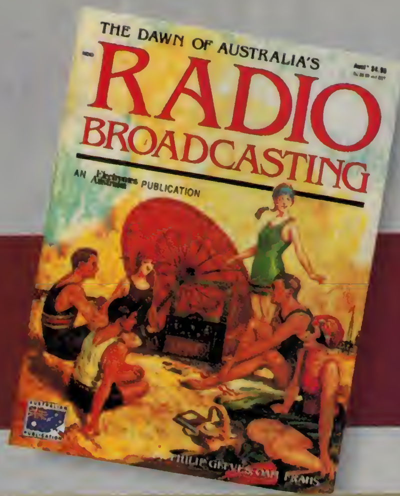

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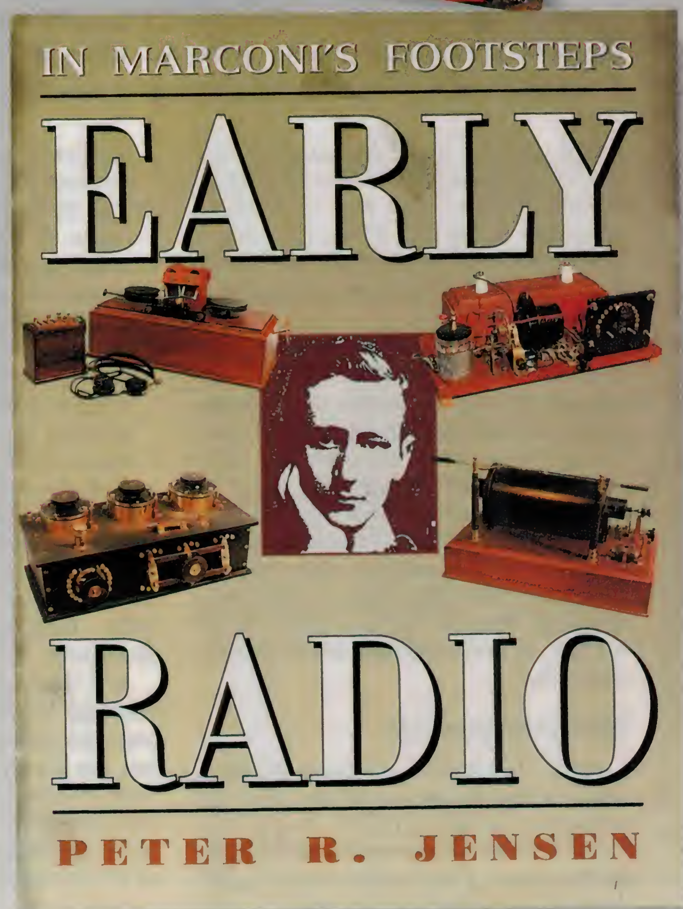

Marconi played a key role in developing radio as a practical medium of communications, and although there have been a number of books written about him, in this new one Peter Jensen has taken a rather different approach. The basic chronological account of Marconi's life and achievements is intertwined with a separate but linked narrative of Peter's own recent visits to key sites, such as the Villa Grifone near Bologna, Salisbury Downs, Dover, Poldhu and Clifden.

For the more technical reader, there's also a 'second half' of the book giving an expanded description of many items of Marconi's equipment and construction details for making replicas.

It all makes much more interesting reading than most other books dealing with this kind of subject.

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Information centre

Conducted by Peter Phillips

Double-takes and lateral thinking

A reader gives good reasons for not playing around with lightning, we acknowledge an error and discuss maximum power transfer from a solar panel. As well, there's details on modifying the Sept/Oct '93 EPROM programmer project to accept 27512 EPROMs, and more...

Our opening letter this month is one that should teach me a lesson. Or perhaps several lessons. The first is I should remember to find out all the facts before passing serious comment, and the second is not to always assume an aggrieved reader is right.

I'm referring to a letter from a reader (Robert Mills, Matraville, NSW) that I included in the December '94 column, under the heading 'Suspect repair job'. The letter was about the operation of his multimeter after it had been repaired. Basically, the meter showed a 10M error on the 2000M ohm resistance range. My rather pompous advice was 'see the manager of the repair firm, as something is wrong.' But it's Mr Mills and I that are wrong, as our correspondent politely points out...

Multimeter error

In the December '94 issue of EA, a reader enquired about a repair job on his multimeter model Q-1535A. As you may recall he was not sure about the original performance of the suspect meter and I would like to clear it up for him.

The meter in question is a Dick Smith Electronics model Q-1535A and despite its low cost, is a very good meter. However if you refer to the owner/operators manual, (and let's face it, how many of us electronic geniuses ever humble ourselves and read the manual?), you'll find that this particular meter has a flaw in the design.

Page 8 of the manual, under the auspicious heading of 'NOTE' is this little gem of information, which I have written here word for word:

1. All resistance ranges on the DMM, except the 200 ohm range, are low power ohms. This allows accurate measurements of in-circuit resistance because the test voltage is below that necessary to activate a diode junction.

2. The 2000M ohm range has a fixed 10 count in its reading. When the test leads are shorted together in this range, the meter will display 010 in the 2000M ohm range. This reading must be subtracted in order to obtain a true measurement. For example, when measuring a resistance of 100M ohm on the 2000M ohm range, the display will read 110.

I discovered this after an instance when I required a high resistance reading and wasn't happy with the results. I hope this will get to Robert before he gets to that manager! Thanks for a very enjoyable magazine. (Raymond Black, Brunswick, Vic.)

And thank *you* Raymond, for clearing this up. While I'm surprised that the meter has this idiosyncrasy, it's obviously not the repairer's fault. So like you, I hope Robert Mills has not stormed into the repairer's, demanding satisfaction while brandishing his December '94 copy of *EA* in support of his cause.

Capturing lightning

I have been hoping for a letter like this one. In December 1994, I included a letter from a reader (Patrick McCool, Darwin) who wanted information about storing lightning in a capacitor. Even though I, and probably most readers, realise the dangers associated with such an activity, I purposely included his letter to get some correspondence on the topic. After all, knowing an activity is dangerous is different to knowing *why* it's dangerous.

After reading the letter by your correspondent regarding lightning experiments, I felt compelled to send some information as I have an interest in and knowledge of high voltage electronics. The first thing I would say (at the risk of being patronising) is DON'T attempt any such experiments. The energy released in a lightning bolt can be in the region of millions of joules. To get some idea of the quantities involved, assume a cloud-ground area of say 1000 square metres, and a distance of 300 metres between cloud and ground (not uncommon). The capacitance can be calculated using a basic equation and for these values is about 30pF.

The voltage is roughly 390 million volts, using a figure of 0.75 metres per million volts. From the equation $V = 0.5CV^2$ the stored energy is 2.3 million joules for this example. To store energy of this magnitude in a capacitor so the terminal voltage reaches say 1000 volts requires a capacitance of about 4.6 farads. Its physical size would be enormous! Note that the smaller the storage capacitance, the higher the working voltage. Using small capacitances is totally impractical.

The situation is further complicated by the fact that the discharge is oscillatory (due to the capacitive element of the cloud-ground and the inductive element of the discharge channel) — hence the multiple strokes. The effect is to dissipate most of this energy as light, heat and sound, so storing the energy is not a simple problem either.

Much information can be gleaned about lightning without resorting to such dangerous experiments. Some ideas are:

(i) Use triangulation to measure the length of a bolt, and hence its voltage.

(ii) Use a fast lightmeter at night to measure bolt brilliance (perhaps a phototransistor, amplifier and storage oscilloscope); then knowing

the distance from the bolt (calculated from the delay before hearing the thunder), create a relative scale of stroke current, since this will be proportional to brightness.

(iii) Using a short vertical aerial (say three metres and preferably indoors) and a wideband amplifier connected to an oscilloscope, observe the waveforms generated by the discharge.

(iv) If the ground is wet, two buried metal stakes in the ground some distance apart and in radial alignment to the storm should produce detectable electrical signals as a wavefront races out from the discharge point.

Ingenuity should suggest many other ways of measuring and calculating energy to at least a rough approximation, without conducting experiments that are potentially lethal. (Malcolm Watts, Wellington, NZ.)

Thanks for this information, Malcolm. By the way, Malcolm is associated with the Wellington Polytechnic, in the Electrical Engineering department, so he obviously has qualifications relative to the area. I just hope Mr McCool is reading, as this is the information he sought. In fact, dare I say that I hope Mr McCool is still alive, as the time has now passed when he intended to carry out his experiments.

Stepper motors

The next letter points out an error in my discussion on stepper motors in the November '94 Experimenting with Electronics section.

I refer to EA November 1994, page 51 Fig.10. If readers have trouble with this circuit it may be because the input voltage to the 78L05 is too low. It is fed from a 6.5 volt line through a diode — leaving about 5.8 volts. According to the National data book, the input voltage required to maintain line regulation for a 78L05 is 7 volts. The problem could perhaps be solved by connecting the 78L05 to the 12 volt rail. Then you'd have plenty of 'headroom'. (A.J. Lowe, Bardon, Qld.)

Yes, of course you're right Mr Lowe. The problem is, I'm not sure whether I've drawn the circuit diagram incorrectly, or if this is how I actually wired the now inaccessible circuit. If the latter, then it's good luck rather than good wiring that the circuit has worked perfectly for nearly 12 months.

However, I'm fairly certain that the circuit diagram is wrong, as a 5V regulator can't work with a 5.8V input. Thanks for pointing out the error.

Lateral thinking

To the lateral thinker, there is always another way to view and possibly solve a problem. Try this simple question, but use lateral thinking to solve it. What's the next number in the sequence 1, 4, 7, 11 ...? (Answer next month!)

Now that I've done my De Bono impression, here's how a laterally thinking reader solved the September '94 What?? question:

I was highly amused to read your solution to the September What?? on the 10 and 11 ohm resistors, particularly given the professional trade flavour of the column and the implied or traditionally implied theoretical/practical approach to solving technical problems. The answer supplied is quite exotic and suggests a far more accurate meter on the ohms range than any I have come across.

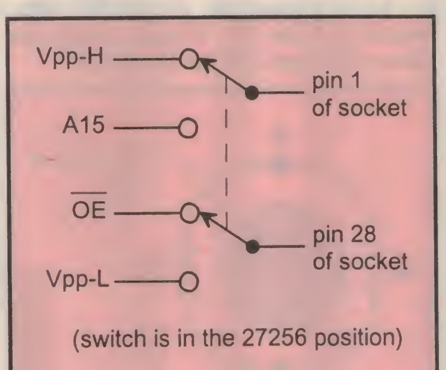


Fig.1

I took a completely different approach and assumed it was a trick question. There is a fundamental difference between the person in the workshop and his young son — their hand size. Your description said that each contributed a handful of resistors to their respective bag(s). Therefore a simple visual observation would show one bag with more than the others and that bag would be the one containing the 11 ohm resistors. A valid approach?

Keep up the column, I enjoy it and I particularly admire your courage in admitting your ignorance of some of the subjects presented. It's amazing how most professional writers spend so much effort in cleverly using generalisations to try and cover their ignorance. Most of us know that journalists (hope that's not an insulting term) are like the rest of us and don't know everything, except they won't admit to it. (Graham Goeby, Greensborough, Vic.)

I suppose the best solution to a problem is the one that gets the right answer in the simplest way. Given that Graham is quite correct about the hand size of the participants, it seems a reasonable, and even practical technique to solve the problem. Of course, it hinges on both parties having put no more than one handful into the bag!

Thanks for this lateral approach, and thanks also for your nice comments about my presentation style. In taking an honest approach, I run the risk of being branded technically incompetent, but I think most readers prefer someone who admits their failings. It's impossible to know everything in this field, and as I've said before, the older I get, the more I realise how little I know.

But there are some things I *do* know, including a response to the next letter...

Solar panel power rating

I read your column with interest and amusement each month. Occasionally there are things in it, or elsewhere in the magazine, which cause me a double-take and I consider writing about it. But in the November '94 issue, a paragraph in your co-written project with Conrad Marder, the Intelligent Solar Battery Charger, caused me much more than a double-take. I quote the sentence concerned, 'But the panel is rated at 12 volts, as this is the voltage at which it transfers most power.' ??

What a beauty. I'm sure your 'inward correspondence' tray is full and your face a deeper shade of red on this one. Just in case it has not been picked up by anyone else, here is my understanding of the subject.

Briefly, a solar panel is a current device, and as such is a constant current source when illuminated. This can be seen by comparing the peak power current (Ipp) with the short circuit current (Isc). For example, the published data for a Solarex MSX- 60 gives Ipp as 3.5A and Isc as 3.8A. If we now take the 60 watt rating and divide it by 12 volts, surprise! — we get 5A. As we've seen, the panel can't deliver that much. Now take 12 volts and multiply it by Ipp (3.5A). Another surprise — it's only 42 watts. What has happened to the other 18 watts?

To find it we divide the panel power rating (60W) by the peak power current (3.5A) and get as a result a little more than 17.1 volts. This then is the voltage at which the panel transfers most power, not 12V as stated in the project text.

All that aside, I am looking forward to the second part of this project. Keep up the good work. (Ian Maitland, East Seaham, NSW.)

Maximum power transfer is one of those topics that can cause more confusion (and arguments) than an operator's

manual for a VCR. From your figures, Ian, it seems the Solarex MSX-60 panel does deliver its maximum power at 17.1V. However I'm not totally convinced, as maximum power transfer occurs when the load resistance equals the source resistance.

A solar panel, like any current source, has a source resistance. I suspect that extrapolating data is not an accurate way to get the voltage for maximum power transfer. Instead it should be done by actual measurement. In any case, the panels sold by Oatley Electronics are not Solarex MSX-60's.

While I didn't do the actual tests to find the voltage for maximum power transfer, I have confirmed with Oatley Electronics (suppliers of the kit for the project) that they did a number of tests with the panels they sell. They found their 12V rated solar panels transfer maximum power when connected to a 12V battery. Higher or lower battery voltages result in less power transfer. For this reason, and given that the main use of a solar panel is to charge a battery, these panels are rated at 12V.

And while we're on the topic of this project, here's another letter, this time seeking information about the regulator.

Battery charger

I have a number of questions about the solar panel regulator/charger recently described in EA. In a caravan park I would prefer to use a 240V charger, rather than setting up the panel. What would be the basic requirements? If I use a 300W transformer, would 12V AC do, or would I need a higher voltage, say 18V. Also does the circuit need a filter capacitor?

I have two refrigerators that take about 4A each. As well, they won't tolerate an AC voltage above 1.4V. With a battery attached, will this charger meet these requirements? Ian Catt, Surry Hills, NSW.)

Since you wrote Ian, the second part of the article has appeared, so you probably already know some of the answers to your questions. The charger/regulator will satisfy your needs in all respects. On page 71 of *EA* for December 1994 you'll find details about using the regulator with a mains-derived DC source. The DC input voltage should be around 16 to 18V, so the AC input will be in the order of 12 to 14V. And yes, the circuit does need a filter capacitor of 1000uF or more.

Because the regulator doesn't have inherent current limiting, add a resistor of some sort between the rectifier circuit and the regulator. A coil of heavy gauge wire or similar is all you need, with a value that keeps the charge current to a reasonable value. It's not possible to give a resistance value, as this will depend on the rectifier voltage, the internal resistance of the rectifier and so on. However, start with a resistance of around four ohms to get a charge current of say four or five amps.

To power the two refrigerators, you'll obviously need to increase the battery charge current to at least 8A. The regulator can certainly handle that value of current, and the battery itself should keep the AC component below 1.4V AC. However don't run the refrigerators from the regulator without the battery attached, as the AC component and the DC voltage could rise above safe levels for the equipment.

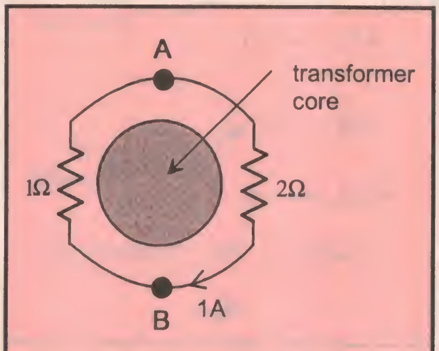


Fig.2

Blue lights

The question why police lights are blue (What?? June '94) has resulted in a number of letters offering reasons other than the answer given in July. Here's a letter that suggests there's nothing technical about the reason at all.

Why are police lights blue? There may be a much simpler explanation than considerations of our eyes' sensitivity. As long as I can remember, and that goes back a long way, police stations had a blue light outside to identify them, both here and in England. When police put flashing lights on their vehicles, they probably just stuck with blue. At that time fire engines had flashing red lights and ambulances and other emergency services used flashing amber lights.

These days all the 'real' emergency vehicles follow the American(?) practice of flashing red and blue lights. I wonder if this has anything to do with the large number of drivers who are colour blind (some 4% of men are colour blind).

Traffic lights are red probably because red has been used to indicate danger for many years, while green means safety. The traffic lights in central Melbourne in the 1930's and 40's had the lights arranged red-amber-green for one street, and green- amber-red for the cross street. I understand that they used a single lamp at each level, with the coloured lenses placed around it. Think what effect this had on a colour blind person who confused red with green! (Alan Fowler, Balwyn, Vic.)

I tend to agree with you Alan, as there are many examples of this sort of thing. For instance, I believe the reason England decided to have right-hand drive is based on the medieval notion of keeping the right hand (the sword arm) free in case a foe approaches. A more pragmatic Henry Ford reasoned it was a right- hand world, so the gear stick and other controls should be on the right of the steering wheel. Hence left-hand drive...

EPROM programmer

Here's a letter from the designer of the Sept/Oct '93 EPROM programmer project. This project has clearly sparked a lot of interest, and the following describes how to modify the design to accept 27512 EPROMs:

As the designer of the EPROM programmer project, I have received a number of requests on how to modify the programmer to accept 27512 EPROMs. The original design is for EPROMs up to the 27256, but I made sure that there were additional high-order address lines available on the main board to make such modifications possible.

The modification is relatively simple and only requires a few bits of wire and a DPDT toggle switch or similar. The modification is based on data provided for a National Semiconductor 27C512. I have not tried the modification myself, but I have little doubt it will work for this and probably other 27512's. Here are the details...

1. On the second PCB which contains the sockets for the EPROMs, desolder two connections to the second socket (28 pin). These are: pin 1 (which connects at its other end to the Vpp-H signal on the main PCB), and pin 22 (connected to output enable on the main board). However, leave both these leads connected at the main PCB.

2. Solder a new wire from the main PCB at the address 15 connection. Refer to the overlay published in the

original EA article (the address 15 connection point is a pad between U4 and the edge of the board). Make the wire long enough to reach the lid of the programmer.

3. *Mount the new DPDT switch at a convenient place on the front panel of the programmer and connect new wires from pins 1 and 22 of the 28 pin socket, long enough to reach this switch.*
4. *You will need an extra connection to the Vpp-L signal from the main PCB. However, the easiest way to get this is probably to make the connection where the Vpp-L line is soldered onto the rotary switch on the front panel of the programmer.*
5. *Wire up the DPDT switch as shown in Fig.1.*

When the programmer is used, ***make sure that the new switch is set to the 27512 position and the existing '28 pin' toggle on the programmer is set to the 27526 position.***

Modification to the programming software may also be needed. The data sheet on the National devices indicates that programming must be done by sending the chip-enable (CE) low for a specified time (either one 10 millisecond pulse, or up to 20 x 0.5 millisecond pulses per address until a successful write occurs), while Vpp is on. Verify is done with Vpp switched off and CE low. The data sheet says the device MUST NOT be programmed with a DC signal on CE (i.e., by switching Vpp on and off for the required time).

Regarding software for the programmer, I have reviewed a number of packages, including one I wrote myself. The review is in EA November '94. I have recently modified my own software to ensure it's compatible with the 27512 programming requirements. The modifications also include a major redesign to provide a more powerful and graphical user interface which combines the read and write functions in one module, and also adds a 'compare' function and other features. It is still available for $10 (or $5 for upgrades). See the Marketplace classifieds in December '94. (Glenn Pure, 66 Crozier Circuit, Kambah ACT 2902.)

I've included Glenn's address for those who might want to correspond with him about this project, or order the revised software.

VCR input for a TV

When VCRs became a household item, quite a few brands of TV receivers had to be modified to accept the slightly different signal of a VCR to that of an off-air signal. The modifications were usually in the sync or horizontal oscillator areas of the TV, to stop 'flag waving' and other problems. At the time, I was familiar with quite a few of these modifications, as the information was freely circulated by TV manufacturers. However, I don't have any information to help our next contributor. Perhaps a reader can help...

I have two Philips TV receivers: one is a 1976 set, model KD655 and the other is an even earlier receiver, model KJ239. Neither set will accept a VCR input. I understand that it is possible to modify older receivers to work with a VCR. Has EA ever published an article showing how to fix old sets of this type? I have circuit diagrams for the sets. (B.F. Cooper, 9 Wolsten Avenue, Turramurra 2074.)

Unfortunately because they are different for each type of receiver, we haven't described how to go about these modifications. If a reader can assist, we and Mr Cooper will be most grateful.

What??

This month's question concerns transformers. It's from Peter White, of Beecroft in NSW, who writes:

This is a classic question that has been around for many years. A transformer has been designed so its secondary winding has an output of three volts per turn. A single turn secondary winding consisting of a one-ohm and a two-ohm resistor in series is wound around the core of the transformer. Given that a current of 1A flows in the winding, what voltage will a voltmeter show when connected between points A and B of Fig.2?

Answer to February's What??

The answer is 0.5 ohms. To solve the question, electrically connect all points of the perimeter of the grid (which is at infinity, so don't ask how to do this!). Inject (in theory) a current into the network of one ampere between the perimeter and point A so the current flows into point A. From the symmetry of the network, the current in all resistors connected to point A (for of them) will be 0.25A.

Disconnect the source and connect another current source between the perimeter and point B. Set it so there's 1A flowing out of point B, with, by the same reasoning as before 0.25A in the four resistors connected to point B.

Now connect both sources to the network together. This means a current of 1A flows into point A, and out of point B. Therefore, a current of 0.5A flows in the resistors between points A and B. By Ohm's law, the resistance between these points must be 0.5 ohms, as the voltage across the resistors is 0.5V (IR) and the current is 1A. ❖

NOTES AND ERRATA

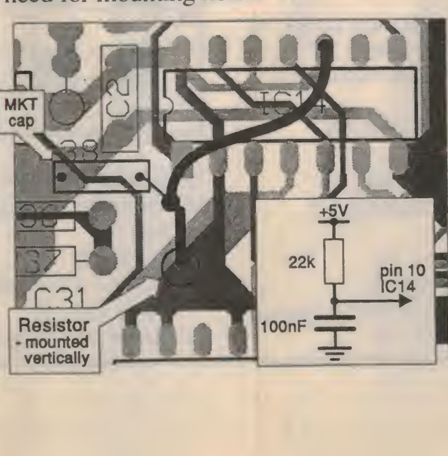
The IMP Loudspeaker Testing System (July, August and September 1994): The schematic diagram on page 58 of the August 1994 issue shows two C20's — the one connected to pin 10 of IC17c should be labelled C5.

Also some recently built IMP modules (particularly those using the uprated MAX191 A/D converter) tend to lockup when power is first applied, and don't respond to commands from the PC. After some investigation it appears that the state of the MAX191's control lines at switch-on causes a conversion to start (the 'sample' LED comes on), but not complete. To force the circuit to power up in a more orderly manner, a power on reset network needs to be added to the GO/GO-bar flipflop stage (IC14).

The circuit shown in the accompanying diagram holds IC4b's SET line (pin 10) low for a moment as power is applied, which in turn forces IC14a into an appropriate reset state.

The main section of the diagram shows the relevant part of the IMP circuit board, where the board's top (component side) layer is shown as dark grey and the bottom layer appears as light grey.

Drill four small holes in the PCB and mount the components as hown with the free legs joined under the board, then cut the track to pin 10 of IC14 and install the insulated wire link on the underside of the board. While this is probably the neatest way to add the extra components, they could be simply soldered to the underside of the board thereby avoiding the need for mounting holes. ❖



50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

March 1945

Large helicopter: Igor Sikorsky is working on the designs for a helicopter designed to carry a minimum of 14 passengers, for use as an 'aerial bus' after the war.

Television in UK: It is expected that television broadcasts will be returned in Britain within a month of the end of the war with Germany.

Engineers are already reconditioning the Alexandra Palace transmitter which before the war gave Britain and the world the first regular television service. As soon as the Palace service is functioning five other transmitting stations will be opened.

Pointers to FM expansion: In America in 1938, there was only one experimental FM station, but seven in 1939 and eleven in 1940. In 1941, FM was authorised on a commercial basis and 34 stations were operating — 18 commercial, two non-commercial and 14 experimental. The figure grew to 48 during 1942 and when further expansion was halted by war, over 100 individuals had applied for station licences.

In Australia, according to a statement recently made in Parliament, a total of 36 applications have been made for permission to operate FM broadcasting stations. All have been deferred pending submission of a general report from the Parliamentary Standing Committee on broadcasting.

March 1970

Darwin booster station: The high power Radio Australia booster station established at Darwin commenced regular transmissions on December 20 1969.

This date marked the 30th anniversary of the inauguration of Radio Australia. The first transmissions emanated from Lyndhurst in Victoria on December 20, 1939.

The three transmitters at Darwin are all rated at 250kW and all should be operating at full power by March 1970.

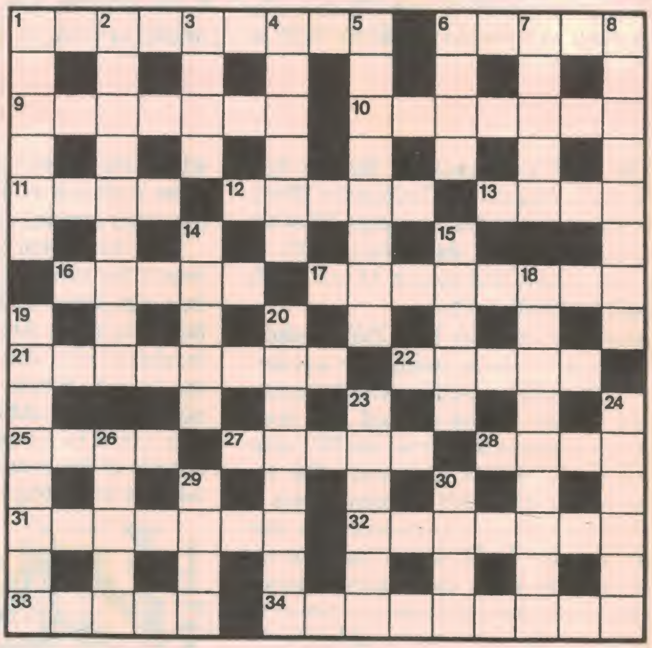
WA radio and television: A national television station and a national broadcasting station commenced operations recently in Western Australia. A television station to serve Geraldton began regular transmissions on December 8, 1969. A radio station to serve the Bunbury/Busselton area began transmissions on December 22, 1969.

In the past 13 years, the Government and private enterprise between them have provided 140 TV stations throughout Australia.

The commencement of television transmissions in the Kalgoorlie area, scheduled for December 29, was delayed due to last minute equipment failures.

The station, ABKW 6, is sited on Peter Hill, two miles north of Kalgoorlie. It will operate on 4kW and will be beamed towards Kambalda and Coolgardie. It will take its programs from Perth via the completed section of the East West microwave link. ❖

EA CROSSWORD



ACROSS

1. The —— Levy comet crashed into Jupiter. (9)
6. Brand of photo-CD product. (5)
9. Item facilitating entry. (4,3)
10. Pertaining to space. (7)
11. Intense in sound energy. (4)
12. Tape-player control. (5)
13. Flux. (4)
16. Calculator key. (5)
17. Delivery of lunar rocket. (8)
21. Expert in aspect of programming. (8)
22. Concerned with hearing. (5)
25. Kind of electromagnetic radiation. (1-3)
27. Capable. (5)
28. Panoramic or —— angle lens. (4)
31. Factor denoted by giga. (7)
32. Type of control. (7)
33. Grounding body. (5)
34. Trigonometrical ratio. (9)

DOWN

1. Source of available current. (6)
2. Forming an eclipse. (9)
3. Item for sound recording (abbr). (4)
4. Part of coded security system. (6)
5. Circuit component. (8)
6. Superseded energy unit (abbr). (4)
7. Electric tool. (5)
8. Unit of power. (8)
14. Philips, essentially, is such an organisation. (5)
15. A designated socket. (5)
18. Name given to ionospheric layer. (9)
19. Pliable. (8)
20. Vibration related to fundamental mode. (8)
23. Said of configuration, etc., previously effected. (6)
24. Variable factor of the E-layer. (6)
26. Brand of business machine. (5)
29. Type of antenna. (4)
30. Subnuclear particle. (4)

SOLUTION FOR FEBRUARY 1995

M	I	C	R	O	S	O	F	T		B	U	I	L	D
E		L		H		I		E		U		R		I
T	H	E	R	M	A	L		L	A	G	G	I	N	G
A		A		S		C		E		S		D		I
L	O	R	D		V	A	L	V	E		L	I	F	T
		E		D		N		I		V		U		A
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F		D	I	P	O	L	E		D	U	B	B	E	D
L		O		S		A		P		S		A		
O	P	U	S		S	T	E	E	R		A	R	C	S
T		B		A		I		N		S		G		W
S	I	L	I	C	O	N		N	O	T	G	A	T	E
A		E		I		U		I		O		I		A
M	U	T	E	D		M	O	B	I	L	E	N	E	T

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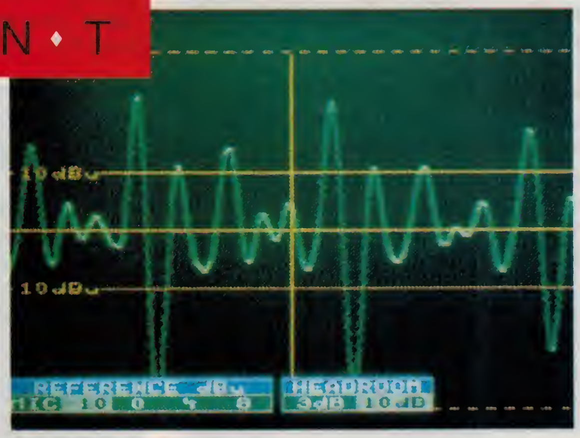
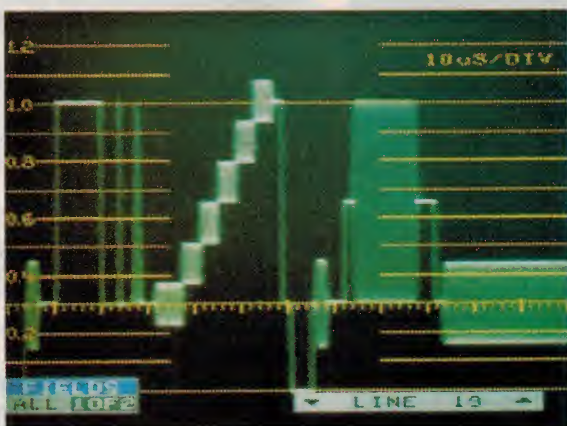
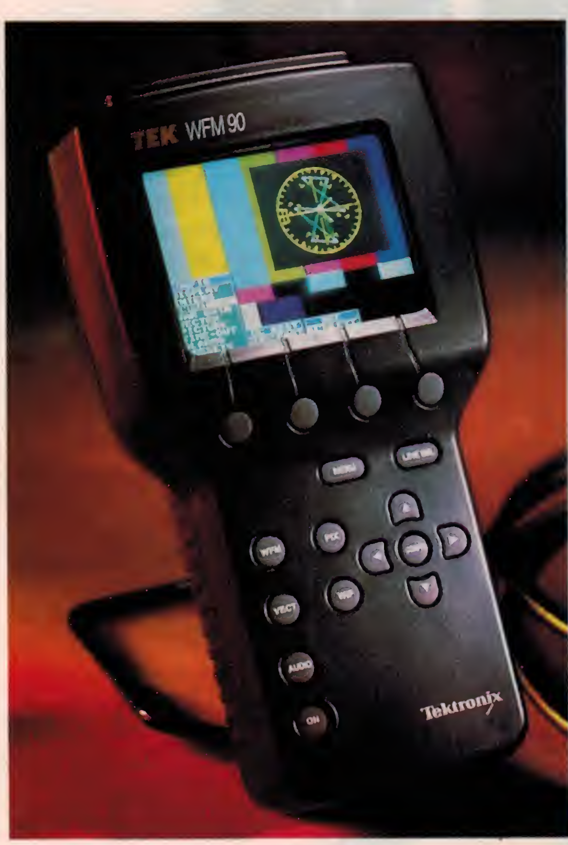
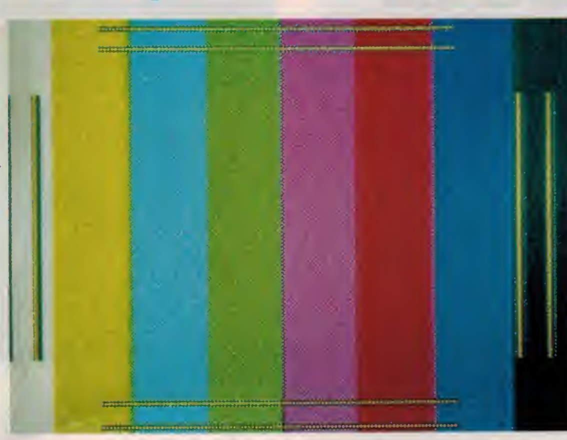






TEK'S NEW WFM90 HANDHELD WAVEFORM, VECTOR, AUDIO & VIDEO MONITOR



NEWS HIGHLIGHTS

VNG NEWS UPDATE

Dr Richard Brittain of the National Standards Commission advises that a new AWA digital announcing machine has been installed at Australia's Standard Frequency and Time Signal Service Station VNG, which operates from the CAA facilities at Llandilo in NSW. The machine replaced the mechanical tape machines which were used at VNG for many years, and is now working well. The funds to acquire the machine were generously donated by VNG Users Consortium member Mr Peter Lord.

A 2kW STC 4SU55D transmitter formerly used by 2KA in the Blue Mountains has also been installed for the 2.5MHz transmissions, replacing the Harris-Gates transmitter which had become unreliable. A further 10kW STC 4RSU48B transmitter has also been purchased from the National Transmission Authority. An aluminium and glass partition has been added to the transmitter hall, to prevent the 5.0MHz, 8.638MHz and 12.984MHz transmitters from disturbing the operation of the CAA airconditioning system.

Currently the 2.5MHz and 5.0MHz transmissions are continuous, with a talking clock announcement each minute and spoken station ID every 15 minutes. The 8.638MHz and 12.984MHz transmissions are continuous with no voice announcements but a 'VNG' Morse ID every 15 minutes, while the 16MHz transmission is between 2200 and 1000 UT with a talking clock each minute and spoken station ID every 15 minutes.

For further information contact National Standards Commission, PO Box 282, North Ryde 2113.

PARKES, MOPRA SCAN FOR PHOENIX/SETI

Australia's 64m Parkes and 22m Mopra radio telescopes are currently scanning the southern skies 24 hours a day on over 28 million frequencies, for signals from intelligent life forms on other solar systems, as part of Project Pheonix (which took the place of NASA's SETI Institute, effectively closed by US Congress in late 1993). The scanning is being carried out as a joint project by Project Pheonix and the Australia Telescope National Facility (ATNF), using the two telescopes in 'pseudo interferometer' mode.

The existing equipment at Parkes and Mopra has been augmented for the project with special front-end and signal processing equipment sent from the USA. The Phoenix front-end fitted to the Parkes RT covers from 1.0 to 3.0GHz, with a system noise of -25K, while that fitted to the Mopra RT covers from 1.2 - 3.0GHz with a similar system noise figure.

The Phoenix back-end spectrometer fitted to both telescopes has a total of 28.77 million channels, and accepts two signals from the front end, each with a bandwidth of 10MHz. This gives various resolutions, from 1Hz to 28Hz. Pattern recognition detectors are programmed to look for continuous-wave and pulse signals, both drifting and stable. A limited number of very narrowband channels (as fine as 0.01Hz) can also be monitored, collected in 10 groups which can be positioned anywhere in a 200MHz slice of the band.

Project Phoenix leader Dr Jill Tarter is remaining in Australia during the scanning, and was quoted in a *Sydney Morning Herald* story as saying "I certainly don't want to be on the wrong side of the planet if something happens".

The scanning will continue until June, when the Pheonix equipment will be taken to a site for scanning the northern skies.

PACIFIC POWER'S $45M FOR UNSW SOLAR

In an agreement that is claimed will change the global economics and environmental impact of electricity generation, Pacific Power is to contribute $45 million over the next five years to join a partnership to accelerate UNSW's latest solar cell technology.

With the contribution from Unisearch Ltd of patents and other intellectual property valued at $19 million, the partnership will initially be worth $64 million. This is the biggest such development contract in Australia's history.

It will position Australia right at the front of the renewable energy industry, an industry that could earn billions of dollars for Australia and defuse increasing international competition for decreasing fossil fuel reserves.

The partnership will develop the multi-junction thin film photovoltaic technology breakthrough announced by Professor Martin Green, Director of UNSW's Centre for Photovoltaic Devices and Systems, and Unisearch in May last year.

The multi-junction technology makes use of UNSW's laser-grooved buried contact solar cells, which are already the most successful technology to be commercialised out of research at UNSW and are also the most successful solar cell technology to be commercialised internationally.

The new technology also employs a novel design that permits the use of very small amounts of silicon, which may be up to 1000 times less pure than silicon in present day cells.

CHINA CRACKS DOWN ON PIRACY

According to a Hong-Kong based legal firm specialising in copyright matters, the People's Republic of China is taking increasing steps to strengthen and enforce its intellectual property laws. A report prepared by Deacons Solicitors and Notaries Public states that nearly 10,000 cases of trademark infringement have been investigated in Guangdong province alone during the last 10 years, and that during the first six months of 1994 about six million pirated books were seized — compared with only three million for the whole of 1993.

The report notes that "The Chinese authorities recognise that China cannot expect to fulfil its foreign economic policy without providing effective protection to the owners of intellectual property rights. Foreign intellectual property owners can look forward to greater protection in the future."

In major cities, China has set up special intellectual property rights courts which are empowered to impose

prison sentences of up to seven years. Raids on suspected shops and factories have increased substantially, according to the report.

ITES LOAN FOR LOCAL SMARTCARD CO

Australian software company Security Domain is poised to expand its overseas markets through the export of its 'Smartcard' technology to Asia and Europe. Australia, through its International Trade Enhancement Scheme (ITES) has granted Security Domain a loan of $600,000 to assist the company in gaining a greater share of the growing world wide market for smart card applications.

Mr David Gemmell, National, Manager for ITES, said the Austrade loan would help the company establish international markets for two of its software products, digital mobile communications and electronic message security systems.

"The products are state of the art technology, and the involvement of an Australian company in leading edge technology will undoubtedly have a pull-through effect to Australian industry," Mr Gemmell said.

"In addition to employing an additional 25 staff over the first three years of the project, it is estimated that the project will generate $19.2 million net foreign exchange earnings for Australia," he said.

The company aims to gain a 10% share of the market for 'smart card' applications in the world wide mobile communications market over the next five years.

PHILIPS MPEG-2 FOR MTV NETWORKS

MTV Networks Europe, a division of Viacom Inc, and Philips Electronics of the Netherlands have agreed that MTV Networks Europe will acquire from Philips a digital video compression system for distribution in 1995 of a portion of MTV Networks programming to cable operators across Europe.

MTV's agreement with Philips Electronics is for a Digital Video Broadcasting (DVC) compliant MPEG-2 compression system, including a smart card based conditional access system called CryptoWorks, together with an SMS (Subscriber Management System).

STANILITE WINS $1M NAVY RADIO CONTRACT

Australian defence and communications company, Stanilite Electronics has been awarded a contract for the design, supply, integration, installation and setting to work of a Distributed Antenna Selection System for the Royal Australian Navy's Receiving Station at Shoal Bay in the Northern Territory. The contract value is in excess of $1 million.

The project provides for the replacement of ageing land-based High Frequency radio switching equipment.

British company Sensors Technology Ltd has developed a small add-on device for PCs known as the 'EconoWhiz', which switches off the monitor to save power if a key hasn't been pressed for a preset time. It connects into the keyboard and monitor cables. The firm is seeking an Australian agent, fax 44 705 469111.

Stanilite proposes to use British company, Raven Research equipment for installation in the facility.

The United Kingdom element of the contract will undergo factory acceptance tests prior to delivery to Stanilite in Sydney, where it will be integrated with the remainder of the equipment, and set to work prior to installation at the Shoal Bay facility.

The proposed system provides for the switching of antennae between a number of radios without blocking. The contract includes the provision of total integrated logistic support, including training, documentation and spares support. Stanilite will also provide follow on support in the form of warranty and a through life support package.

SOFTWARE USES GPS FOR TRACKING

A company in Mackay, Queensland, has developed a fleet management system software package that can accurately position any vehicle on land, sea or air. According to Sattrac Australia managing director Ross Proud, the system can track vehicles at long or short distances by using the global positioning system (GPS).

"Our system can monitor a position anywhere in the world using a satellite system," he said. "It determines the longitude and latitude of a vehicle and transmits it to a computer."

"The program can be tailor-made to meet client needs. It can pass on any information you wish to send and can pick up any information you wish to receive."

Mr Proud said the company had developed a system that combined three elements: the global positioning system, communications and software.

"Communicating in this manner is very cost efficient and, once set up, cheaper than using a cellular phone," he said. "There is also a safety advantage of being able to instantly communicate and locate an operator when something goes wrong."

The Sattrac program was developed primarily for the transport market, but Mr Proud is looking to develop the product further.

(Sattrac Australia, PO Box 482, Sarina, Queensland 4737; phone (079 43 1377, fax (079) 43 1272.)

56 GOVERNMENTS ENDORSE INMARSAT-P

Inmarsat's plans to launch a global handheld satellite phone service by the end of the decade have received the unanimous approval of its Assembly of Parties, which represents Inmarsat's 75 member countries.

The Assembly also agreed to change Inmarsat's formal name from the International Maritime Satellite Organisation to the International Mobile Satellite Organisation. Inmarsat, a 75-member country cooperative, was originally set up 15 years ago to provide commercial and distress and safety communications for the maritime community. It has since

evolved to provide mobile satellite communications for aircraft in flight and land mobile users around the world.

Fifty six governments sent representatives to the London meeting to discuss Inmarsat's plans to form a separate, private affiliate company to provide the Inmarsat-P service. The Assembly decided that it was 'desirable that Inmarsat be involved in the provision of hand-held mobile satellite services... and that the formation of the Inmarsat-P affiliate to implement Inmarsat-P services is consistent with the Inmarsat Convention', providing certain principles are met.

These principles include that Inmarsat be able to carry out its public service obligations, that the affiliate competes on a fair and open basis, and that mechanisms be established to ensure the participation of developing countries in the decision making process of the affiliate. Specifically, there will be no cross subsidisation between Inmarsat and the Inmarsat-P affiliate, and mechanisms to prevent this have been discussed.

ROCKWELL WINS DEFENCE INDUSTRY Q&A AWARD

Rockwell Systems Australia (RSA) has won an Australian Defence Industry Quality and Achievement Award for the Royal Australian Navy Magnetic Measurement and Treatment Facility in Western Australia. The award is in the category of Capital Equipment Projects under $20 million, and was presented by Senator Robert Ray, Minister for Defence, who commended RSA's quality and achievement in the presentation ceremony.

Garry Jones, deputy secretary, acquisition and logistics, stated "RSA has clearly demonstrated its capability to produce an innovative design for a product that is highly competitive throughout the world. The extensive use of Australian industry as suppliers for the ranges project shows that. the quality of Australian products are world class." He further stated, "The Magnetic Ranges and Magnetic Treatment Facility has provided the Royal Australian Navy with a world class capability that was previously unavilable in Australia."

RSA and its major subcontractor, Thorn-EMI (UK) supplied two separate systems. The Magnetic Measurement Range feeds information from sensors on the sea bed to a shore based computer data logging system. This information is processed to provide a 'magnetic signature' for a vessel. The system also provides data to assist in minimising the magnetic signature of RAN vessels to reduce the risk of detection by magnetic mines.

The Magnetic Treatment Facility includes a large berth for the vessel under treatment, which is subjected to electromagnetic fields controlled to modify and reduce the signature measured by the magnetic range.

The German Inter Nationes press service sent us this picture of a prototype solar powered buggy made in Eastern Germany by Solar Nord GmbH of Wismar. The solar cells on the roof generate 300W of DC to charge the onboard batteries, giving the vehicle a range of 40km and a top speed of 50km/h.

SINGAPORE BUYS OGENIC DIGITAL RADIO

WA based Ogenic Technologies has just been awarded a major tender by the Singapore Goverment to supply and install radio broadcasting equipment for Radio Singapore International (RSI).

Competing against some of the leading European and American radio broadcast suppliers, Ogenic secured the tender worth around $2 million. Ogenic is transforming the recently completed RSI building from an empty shell to a fully operational radio station, due for completion this month (March).

The equipment to be installed at RSI represents some of the finest digital technology available to radio stations today and provides the station manager with the capability to fully automate up to five services simultaneously, all from one central location.

RSI's Project Manager, Mr Lai Wing Hin explains that "the criteria specifications were very important. We compared all tenders against this criteria and then awarded it to the company who fully complied with our specifications and requirements."

Ogenic's 19 years experience in the broadcasting industry has equipped it with the capabilities to provide its leading edge technology to radio stations internationally.

Ogenic's reputation through the Asia-Pacific region is flourishing, with this being the third major tender win in Singapore over the past 12 months. According to Ogenic's Marketing Manager, Mr Rick Dunn, "Our commitment to quality and service is well regarded in the Asian region and this should continue to give us the edge as we push further into this growing part of the world."

PHILIPS' TAIWAN TUBE PLANT OPENS

Philips Display Components' new 600 million guilder colour PC monitor tube factory was officially opened in December by Mr Jan Timmer, president of Philips. This investment — the largest ever made by the company in a single activity — includes the installation of five production lines, two of which are already operational.

The factory, located at the Hsinchu Science Park in Hsinchu, Taiwan, is set to produce about 3.6 million tubes per year, when it becomes fully operational in 1997.

Initial plans for the new factory were made in early 1993, and construction was started at the end of that year, while installation of equipment started in July 1994.

The facility consists of a production area of more than 40,000 square metres, some 5000 square metres of office space and a warehouse of 2000 square metres. When fully operational, the facility's 1000 employees will manufacture high end, flat square 15-inch and 17-inch tubes.

MICROELECTRONICS CONFERENCE IN JULY

The 13th Australian Microelectronics Conference will be held from July 16 to 19, 1995 at the Adelaide Hilton, Adelaide South Australia.

The Australian Microelectronics Conference is Australia's premier conference series on microelectronic technology and systems. Under the general theme of 'Microelectronics: Technology Today for the Future', this latest conference in the series will address the technological developments and issues which will feature prominently in Australia's contribution to the global microelectronics industry in the late 20th and early 21st centuries. In turn, the extent of these contributions will have a major effect on the nation's economic well being in the next 10 to 20 years.

Themes selected by the Organising and Technical Program Committees for particular emphasis at the Conference are Microengineering and sensors, Microelectronics for multimedia, Formal hardware verification, Very high speed circuits, Multichip module technology, Nanotechnology, and Industrial Case studies.

Several prominent invited speakers will deliver keynote addresses, including Dr Bryan Ackland of AT&T Bell Laboratories; Professor Jong-Duk Lee of the Seoul National University; and Dr Myung-Hwan Oh of the Korea Institute of Science and Technology.

GLOBAL F-O LINK AGREEMENT SIGNED

Telecommuniations carriers from around the world have signed agreements to build, operate, maintain and use FLAG (Fibreoptic Link Around the Globe) claimed as the world's longest undersea fibreoptic cable system.

Forty parties signed agreements, formalising commitments to purchase telecommunications capacity on FLAG and defining operating and maintenance responsibilities for the FLAG cable system.

FLAG Limited, the operating company, also signed a US$1.2 billion contract — one of the largest in history — with AT&T Submarine Systems and KDD Submarine Cable Systems to construct the FLAG cable system commencing the first quarter of 1995.

"These agreements mark the culmination of over four years work by FLAG throughout the world" said Gabriel Yackanich, president and chief executive officer of FLAG Limited. "With carriers world wide committing to cooperate in the planning and use of the FLAG System, coupled with a world class supplier consortium prepared to construction the system, FLAG is now poised to revolutionise the submarine cable industry. This is truly a historic moment, as it marks the first cable system funded by private investors which permits carriers to purchase capacity at true market rates."

Scheduled for completion by 1997, FLAG will connect three continents along its 27,300 (17,000 mile) route between the United Kingdom and Japan.

Landing stations will be located in the United Kingdom, Spain, Italy, Egypt, United Arab Emirates, India, Thailand, Malaysia, Hong Kong, Korea and Japan.

FLAG's investors are NYNEX Network Systems, a NYNEX company providing high quality, cost competitive network system and services world wide; the Dallah-Al Baraka Group of Jeddah, Saudi Arabia, a large multinational investment company; Marubeni Corporation, one of Japan's leading general trading companies; and Gulf Associates Inc., a New York based corporation that focuses on trade and project development.

NEWS BRIEFS

- A major services and support industry conference and exhibition will be held in Sydney, March 26-29 for Pacific Rim countries, focused on ***Leading the Services Revolution***. For more information, contact AFSM International, 70 Higgingbotham Road, Ryde 2112, phone (02) 365 5666.
- Robert Chapman from Protel Technology has been appointed as the Product Manager, Electronics by ***Critec***. The company designs and manufacturers UPS and transient protection equipment.
- ***COMMTEL CHINA '95***, the International Telecommunications Equipment, Technologies, Networks and Services Exhibition for China will be held from September 8-11 at the China Foreign Trade Centre, Guangzhou. For further information contact Business and Industrial Trade Fairs, Wanchai, Hong Kong, phone (852) 865 2633.
- ***Metromatics*** has been appointed the Australian distributor for Eidsvoll Electronics AS of Norway, which markets PCM telemetry products under the brand name of Eidel.
- The Thailand computer show ***Computer and Communication '95*** will be held May 11-14 and November 23-26. For more information contact Thai Trade Fairs, 822/1 Rama VI Road Phyathai, Bangkok 10400, Thailand, or phone 215 6555.
- ***Kevin Cavanagh*** has been appointed distributor for Advanced Electronic Applications (USA), PacComm Packet Radio Systems (USA), Tigertronics (USA) and CavCom (Australia). For more information phone (074) 64 3 954. ❖

PHILIPS & SONY PROPOSE HIGH DENSITY CD

Philips Electronics and Sony Corporation have jointly proposed specifications for a 12cm high density Multimedia CD. The two companies hope that these will become the basis of optical media for the coming multimedia era.

The new high density CD will be able to store about 3.7 gigabytes (GB) of data. This storage capacity — more than five times that of CD — has been achieved by incorporating a 635 nanometre (red) laser, reducing both the distances between the tracks to 0.84um and the size of the pits and by using highly sophisticated error correction and improved modulation techniques.

The new specifications would allow discs to be produced at conventional manufacturing facilities with only minor modifications. As a result, production costs of the proposed new discs would be similar to that of conventional CD — a major advantage for consumers, media manufacturers as well as for the hardware and software industry.

To enable even further enhanced applications, the new specification includes a dual layer disc, which enables a doubling of disc capacity to around 7.4GB. This technology is being developed in collaboration with 3M. The vastly increased storage capacity and advanced features of high density CDs based on these physical specifications will enable a broad range of applications.

In the entertainment field, a video application of the high density CD, a 'Digital Video Disc' is also being proposed. The 3.7GB disc can carry, for example, approximately 135 minutes of MPEG-2 quality video together with multitracks of compressed digital audio and subtitling. ❖

NEW VIDEO TEST GEAR FROM TEK

Well known for its high performance scopes and other test instruments, Tektronix has released two new compact and lower priced handheld instruments for professional video applications. One is a very flexible PAL/NTSC signal generator, while the other is a picture and audio monitor which also displays waveforms and vector plots.

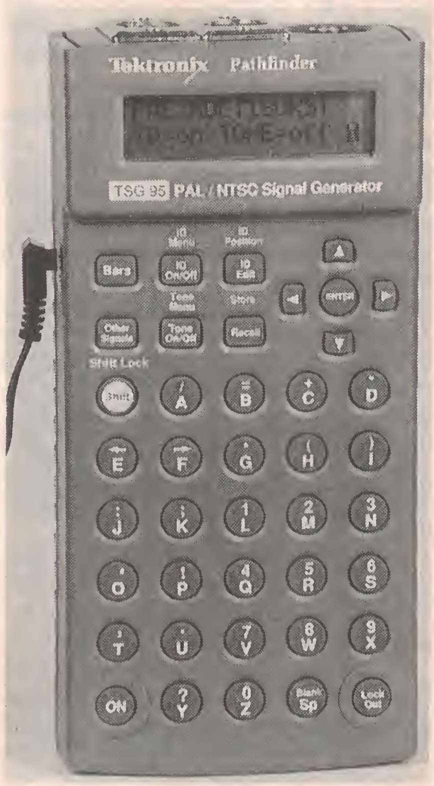
by JIM ROWE

With cable and pay TV at last getting under way in Australia this year, there's inevitably going to be an increase in field installation and servicing work, and consequently a need for compact and reasonably priced test instruments. Perhaps sensing this and similar developments around the world, Tektronix has released two new handheld instruments for video testing work. The TSG95 'Pathfinder' PAL/NTSC Signal Generator and the WFM91 multipurpose monitor are almost a 'pigeon pair', well suited for anyone who needs to generate test signals and/or monitor the performance of equipment handling analog composite video.

Let's look at the TSG95 first. Although this comes in a compact case measuring only 191 x 92 x 56mm, it offers a surprisingly wide range of video and audio test signals. For composite video there are some 20 different primary PAL test signals and 16 different primary NTSC signals, for example, plus another five NTSC variations as used in Japan. In addition, there's a programmable ID message/caption facility, plus a full complement of VITS (vertical blanking interval test signals) available with both PAL and NTSC signals, and these can be turned on or off as desired.

In the PAL domain, which will be of primary interest in Australia, the main test signals include 75% and 100% modulated colour bars, 75% or 100% colour bars over red, green/blue/red fields, 100%/50%/0% flat fields, multiburst, 60% reduced line sweep, bounce test, a five-step grey scale, a modulated five-step scale, convergence test, a 'pluge' (picture lineup generator) signal, a 'matrix' signal (bar + 2T pulse + modulated 20T pulse + 5-step grey scale), a field square wave and a 'safe area display' signal. The VITS signals include CCIR 17, 18, 330 and 331A, with various combinations of bar, sinX/X (2T) pulse and modulated pulse (20T), multiburst and greyscale/bars components; 75% colour bars; 75% red field; 50% flat field; sinX/X pulse; 15kHz square wave; shallow ramp; and UK ITS signals 1 and 2. A similar array of signals is provided in the NTSC domain.

On the audio side, there's a choice of 13 different audio tones, from 50Hz to 20kHz; an audio sweep signal, covering the same range; and also a 'click



sequence' signal, for convenient identification of stereo channels. The audio signal levels can be switched between four preset levels, set initially to -10dBu, 0dBu, +4dBu and +8dBu into 600 ohms but also capable of being reprogrammed in whole-dB steps. Frequency accuracy is +/-0.5Hz, and the audio signal THD is less than 1% within a 20kHz bandwidth.

As you might expect, the TSG95 is basically a digital generator, and is based on a microcontroller system. Presumably the various test signals are all stored in ROM, and read out by the micro as needed. The selection of signals, modes etc., is made via the generator's 'front panel' which features a 16-character, two line backlit LCD display plus a keyboard with some 41 keys.

The user interface uses a friendly menu system, and is quite convenient to use. Six of the keys essentially select control mode menues, while another five are 'cursor movement' keys.

The composite video output from the TSG95 is via a standard BNC socket, while two XLR sockets are used for the stereo audio outputs. All three connectors are on the 'top' end of the case, for convenient hand-held operation.

The TSG95 is powered from 9 - 15V DC, and can operate from either the AC plug pack supplied, from a set of AA alkaline cells or a rechargeable 9.6V NiCad battery pack. The plug pack can also be used for battery charging when the NiCad pack is used.

A nice feature of the TSG95 is an 'auto power down' feature, which causes it to shut down and conserve the batteries if no keys have been pressed for 10 minutes. However this feature can also be disabled, if you find it inconvenient when running directly from the plug pack.

The WFM91 monitor

The WFM91 Video/Audio/Waveform/Vector Monitor would clearly be an excellent companion instrument for TSG95, because it's basically a portable signal monitoring and measuring device. Not surprisingly it's not *quite* as compact as the generator, with a height of 244mm, a width of 127mm at the upper (display) end, and a depth of 81mm at the same end. It's also a bit heavier than the generator, weighing in at 1.4kg including batteries.

But again, the WFM91 manages to cram a surprising amount of

functionality into that modest case. On its 102mm-diagonal backlit colour LCD display, which uses TFT (thin-film transistor) technology, you can display not only an image of the incoming composite video but also a digitised/ rasterised version of the video or audio waveforms, or a 'vectorscope' polar plot of the chrominance information. And these alternative displays can be displayed either full size, or as a 'PIP' (picture in picture) image inset into the main display.

In short, then, it's effectively a video/audio monitor combined with a waveform scope and a vectorscope, all housed in a portable case and able to be run from an inbuilt rechargeable battery pack. Just the shot for the mobile video or cable TV technician, or the broadcast video engineer working on satellite or microwave links, repeaters or translators!

By the way, although the WFM91 is for PAL signals only, an NTSC version is also available — known as the WFM90.

The display modes of the WFM91 are selected using five buttons on the front panel, labelled respectively WFM, VECT, AUDIO, PIX and WIP. The first four select the full-screen display mode, while the last selects the waveform-in-picture or 'PIP' mode, with the last-selected waveform displayed in the small window.

As with the TSG95, the WFM91 is again based on a microcontroller, and its wide range of secondary control functions are selected by means of a menu-based user interface. The menues are activated by pressing a MENU key, and appear along the lower edge of the LCD screen. Menu navigation is then performed by using either four software-labelled buttons just below the screen, or a set of five cursor control buttons. It's all quite easy and intuitive.

In video waveform display mode, the WFM91 can display either one or two horizontal lines, or two fields. The vertical gain can be set to x1 or x5 calibrated, or variable, and with either a flat response (within 2% from 50Hz to 6MHz for x1, within 5% from 50Hz - 6MHz for x5), or with a luminance LP filter (>40dB attenuation at 4.43MHz). The transient response is within 1% for pulse/bar comparison and pre-shoot, and better than 2% for overshoot and ringing in the x1 mode.

In the vectorscope display mode, chrominance amplitude and phase are displayed in the usual 360° polar plot, with a software-generated graticule used for differential gain and phase measurements. Video gain can again be set for x1, x5 or variable, and a variable 360° phase shifter is available.

In the audio display mode, the audio input signal waveform is displayed against time. A software graticule is again provided for reference, indicating reference levels of -10dBu, 0dBu, +4dBu and +8dBu. Rated frequency response is within 0.5dB from 50Hz to 20kHz.

In the picture display mode, you get a standard 'unprocessed' colour display of the incoming composite video signal. If desired a software-generated graticule can be displayed to show the 'safe area', while the picture can also be shifted up vertically to allow viewing of the vertical blanking area.

Other nice features of the WFM91 include the ability to program it to select any desired scanning line (either or both fields), for viewing in the waveform or vectorscope modes; the ability to store frequently-needed custom instrument setups, for rapid recall; an 'amplitude alarm' function, which monitors signal levels in the video and audio waveform modes; a time-out power saving mode, as found on the TSG95; and finally the ability to recalibrate the instrument at any time, using a special menu function.

On the top of the case, the WFM91 provides three BNC-type video connectors and an XLR audio connector. Two of the BNC connectors are composite video inputs (the second being for a reference signal), while the third is a 'loop through' video output. Both video inputs have slide switches to allow them to be either terminated in 75 ohms or unterminated ('HI-Z'). The XLR connector is for the audio input.

On the right-hand side of the case there are two further sockets, one for an external 11-18V DC supply and the other an output for stereo headphones. A 12V/1A DC plug-pack supply comes with the WFM91 as standard, along with a user manual and a carrying pouch with shoulder strap. Available options include a travel pack (for both the WFM91 and TSG95), a NiCad battery pack, a desk stand and a viewing hood for the LCD screen.

Trying them out

Tektronix Australia kindly loaned us both a TSG95 and a WFM91 for a few days, to allow us to try them out both singly and together. We found them very easy to set up and drive, thanks to their friendly menu-based user interfaces.

Examined with a good 100MHz scope, the output signals from the TSG95 generator were excellent, and of virtually 'textbook' quality. There's certainly a very wide range of the signals, too — so the TSG95 should be a great asset in almost any situation where composite video test signals are needed.

The WFM91 also performed very well, using a variety of composite video and audio signals (including those from the TSG95). Both images and waveform/vectorscope displays were very informative, although the LCD screen is not over-bright; in conditions of high ambient lighting levels, the optional viewing hood is very desirable. Like many LCD displays it's also a little critical in terms of viewing angle for optimum contrast; the optimum angle can be set in the configuration menu, but is inherently fairly narrow.

On the whole, though, we found both instruments very impressive. Either separately or together, they should be of great benefit to anyone working with equipment or systems using composite video and audio.

Quoted price for the TSG95 Pathfinder Signal Generator is $1595, and for the WFM91 Waveform/Vector/Video/Audio Monitor it's $3743. These prices are plus sales tax if applicable.

Further information on these instruments is available from the Test & Measuring Products division of Tektronix Australia, at 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066 or fax (02) 888 0125. ❖

Solid State Update

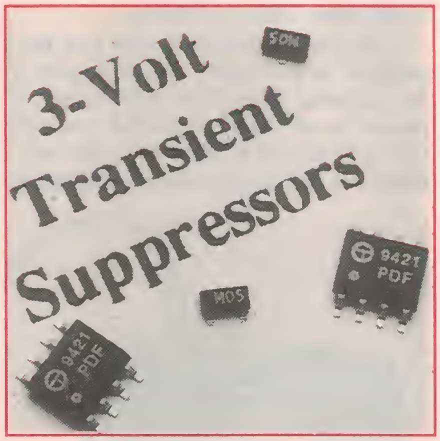
KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

3V transient voltage suppressors

ProTek Devices has developed and is manufacturing what is believed to be the industry's first three volt silicon avalanche transient voltage suppressors (TVS). The new low voltage series is designed for 3.0/3.3 volt applications. Available in standard SOT-23 and SO-8 surface mount packages, these 500 watt devices can protect one unidirectional line (SOT-23), or four unidirectional lines (SO-8).

The series has been designed for board level protection of standard TTL and MOS bus lines in applications where ESD, tertiary lightning and switching (logic levels) and other surges can damage or upset voltage sensitive circuitry. The response time of TVS clamping action is theoretically instantaneous, but the device's clamping voltage values are based on an industry standard characteristic waveform of 8/20us. For faster transient conditions, the actual clamping voltage will be lower for the equivalent transient current.

The devices have a high surge capacity, and can be used for both analog and digital applications. Key features include 500 watts peak power dissipation for an 8/20us pulse and a theoretical response time of 10×10^{-12} second. Rated stand-off voltage is 3.0/3.3 volts, while maximum clamping at one amp is 6.5 volts.



For further information circle 273 on the reader service coupon or contact VSI Electronics, PO Box 578, Crows Nest 2065; phone (02) 439 4655.

Siren driver IC

Zetec PLC has launched a purpose designed siren driver IC. A replacement for dual 555 timer or more elaborate circuits, the ZSD100 needs two timing capacitors, a TO92 Darlington transistor, a piezo transducer and a coupling transformer to create a 120dB alarm siren.

The device can generate a user definable audio frequency signal to 10kHz, and a low frequency sweep signal to 10Hz. It includes disable circuitry, divide by two and output driver stages, allowing the IC to produce a low cost alarm signal for burglar alarm and automotive anti-theft systems.

The ZSD100 is available in either eight pin DIL or surface mount packaging and operates from supply voltages ranging from 4V to 18V. The device is ideal for battery powered applications as it requires a supply current of 10mA when operating and 1uA in sleep mode.

For further information circle 278 on the reader service coupon or contact GEC, Locked Bag 29, PO Rydalmere 2116; phone (02) 638 1888.

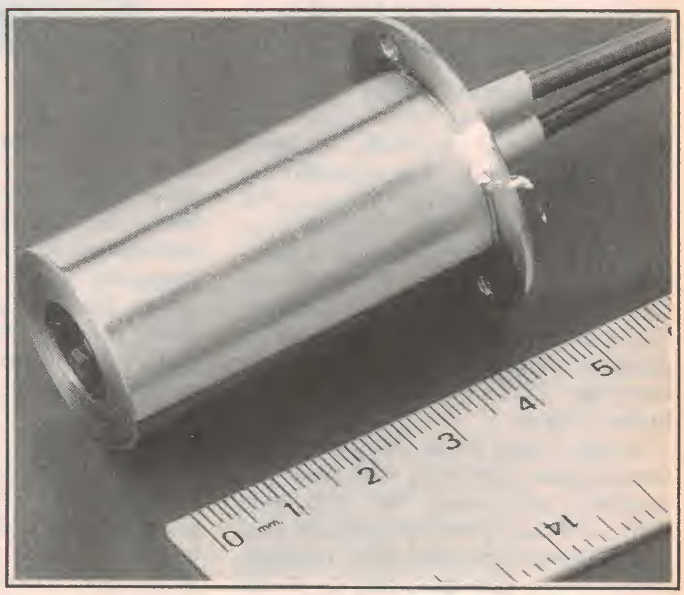
EPROMs operate at 2.7 to 3.6V

Atmel has introduced a family of high speed EPROMs with access times of 70 nanoseconds that operate from an unregulated 2.7 to 3.6V supply.

The Battery-Voltage, or BV family is suited for portable equipment, especially handheld communications equipment. The EPROMs, which are available in one, two and four megabit densities, are not only fast, but they are also light on power consumption.

Current consumption is 8mA at a

Low cost infrared temperature sensor



A new inexpensive, miniature infrared temperature sensor has recently been launched by the US based company, Mikron Instrument. The M50 series Infracouple is aimed at manufacturers who need low cost non-contact temperature readings in automated manufacturing processes. Infrared thermometers have previously been regarded as too expensive for use in low cost applications.

The M50 series is designed to measure the temperature of moving or contact-sensitive materials in automated industrial processes. These include packaging, paper and plastic manufacturing, textile converting and industrial finishing where temperature measurements need to be taken at multiple locations along a production line.

The M50 has two fields of view, wide and narrow and uses standard Mikron optics. It has an accuracy of +/-1.5% with linear and non-linear voltage, and K and J outputs. The unit's operation/temperature span is between 20 and 300°C.

For further information circle 272 on the reader service coupon or contact W&B Instruments, PO Box 189, Carlton South 3053; phone (03) 347 0866.

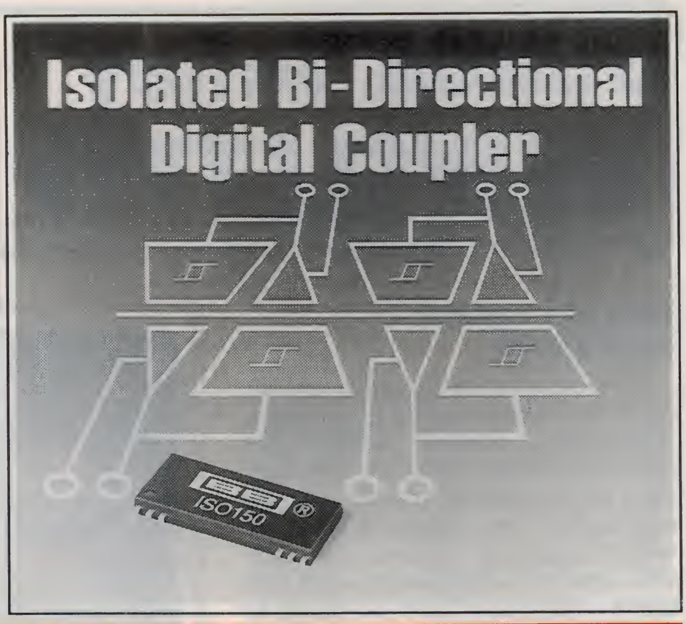
Digital coupler uses capacitance

Burr-Brown's new ISO150 is an ultra high speed capacitvely coupled digital device that provides high isolation with very low power consumption. Designed to replace optocouplers, its applications include digital isolation for A/D and D/A conversion, ultiplexed data tarnsmission, computer-to-peripheral interfaces, I/O port isolation in instruments, power inversion, and isolated data acquisition systems.

The ISO150 uses high voltage capacitors instead of a LED and photodiode to transmit signals across the isolation barrier.

It has two by-directional channels, which can be configured independently to transmit or receive signals across the isolation barrier. It needs no external components and is compatible with CMOS/TTL logic. Key specifications include: 80Mb/s (typ) data rate, TTL/CMOS compatibility, 25mW (max) power consumption per channel, 2400V rms partial discharge test voltage, and 7.2mm creepage distance. The 28-lead SOIC package outline has 16 missing leads in the centre isolation barrier area.

For further information circle 275 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 2700.



supply voltage of 3.6V. Standby current is 20uA. This gives a typical power consumption of 18mW when active, and 3uW in standby mode.

The devices exceed the JEDEC interface specifications for both low voltage unregulated battery operation and low voltage TTL.

For further information circle 276 on the reader service coupon or contact GEC, Locked Bag 29, PO Rydalmere 2116; phone (02) 638 1888.

New non-volatile memories

National Semiconductor has announced new high performance, low voltage CMOS additions to its non-volatile memory range. The nine products include a 16Kb Microwire serial interface EEPROM, six 70 to 100 nanosecond 512Kb to 4Mb EPROMs in x8 and x16 configurations and two 1Mb low voltage, low current EPROMs in x8 and x16 configurations. All devices are available in DIP and surface mount packages.

The NM93C86A 16Kb serial interface EEPROM is designed for low power, processor-compatible operation. It is organised as either 1024 16-bit registers or 2048 8-bit registers via a pin selection.

It features a 400uA active current, 25uA typical standby current, self timed programming cycle, 40 year data retention, 1,000,000 data change endurance, and compatibility with the Microwire synchronous bus for interfacing to microprocessors and microcontrollers.

The six high performance EPROMs are designed for code storage in 100% firmware based systems. They feature no wait state operation, fast programming, fast turnoff for microprocessor compatibility and JEDEC standard pinouts in Ceramic DIPs or plastic surface mount packages for one time programmable implementations.

Designed for power sensitive handheld and battery powered applications, the two 1Mb EPROMs enable code storage for applications such as notebook computers, palmtop computers, cellular phones and hard disk drives. Featuring three to 3.6 volt operation, the NM27LV010 (128K x 8) and NM27LV210 (64K x 16) specifications include a 150 nanosecond access time, 15 to 20mA active current, 20uA standby current, 50mW active power and 66uW standby power.

For further information circle 271 on the reader service coupon or contact National Semiconductor, 16 Business Park Drive, Notting Hill 3168; phone (03) 558 9999.

IC package has 672 'pins'

VLSI Technology has announced the first commercially available tape ball grid array (TBCA) packages for high-pin-count and high performance silicon chips.

Offering up to 672 pins, TBGAs accommodate more than half a million gates and clock frequencies beyond 150MHz, when used with VLSI's cell based and gate array designs. TBGA packaged chips are ideal for cost sensitive, high integration applications, including workstations, supercomputers, parallel computing, networking, transmission and digital television systems.

TBGA packages offer twice as many connections per unit area of printed circuit board compared to quad flat pack (QFP) packages, and cost significantly less per pin than plastic pin grid array (PPGA) packages. VLSI's QFP and plastic ball grid array (PBGA) packages cover pin counts of up to 400 pins.

While PGAs can only be through-hole mounted on printed circuit boards, TBGAs are surface mountable, with widely spaced solder ball connections, resulting in less expensive board assembly and the elimination of bent lead problems often experienced by QFPs.

For further information circle 280 on the reader service coupon or contact GEC Electronics, Locked Bag 29, PO Rydalmere 2116; phone (02) 638 1888. ❖

Silicon Valley NEWSLETTER

Intel will replace *any* Pentium

Apologising to its customers for 'acting like a bunch of engineering types in dealing with a consumer problem', Intel chief Andy Grove announced his company has reversed its position and will now replace any Pentium chip for free without requiring customers to justify their need for a replacement chip. The move could cost Intel as much as US$450 million and months' worth of valuable production time.

Its reputation damaged, Intel finally responded to soothe the growing anger, skepticism and confusion among the millions of Pentium users — and backed down from its earlier policy of replacing Pentium chips only if customers could justify their request for a replacement chip. "To some people this policy seemed arrogant and uncaring. We apologise for that. We will try to be more sensitive to the needs of customers, including the customers on the Internet."

Grove added that "what we viewed as an extremely minor problem has taken a life of its own. We were motivated by a belief that replacement is simply unnecessary for most users. We still feel that way, but we are changing our policy because we don't want there to be any doubt that we stand behind our product", Grove explained.

Depending on how many customers will take Intel up on its offer, the move could cost the company between US$50 and $800 million dollars. The production costs of Pentium chips are estimated at around US$150. Shipping and service costs will add another $150 per customer.

The replacement program is also likely to keep the chip in relatively short supply during 1995. That will keep prices of Pentium computers artificially high, which will help Intel's competitors, such as AMD, Cyrix, and Nexgen. Apple Computer will also benefit as the company will be in a better competitive position with its PowerPC Macintosh systems.

At IBM, which dealt perhaps the most serious blow to Intel's credibility by its decision to stop selling Pentium-based computers, spokesman Mike Reiter said "IBM is pleased with Intel's decision to support its customers."

Our Silicon Valley correspondent Paul Swart didn't catch what the salesperson was saying to this customer as he tried out this rather amazing contraption at the last Comdex show. But Paul suspects it may have been along the lines of "See how comfortable they are. Now, how would you like to pay for one?" It appears to be a cross between an ergonomic chair and a flight simulator.

Olivetti startup first with Mac clone

Perhaps surprisingly, it is a virtually unknown start-up company in Milpitas in Silicon Valley that will end up being the first company to enter the PC market with a Macintosh clone.

Power Computing, whose largest shareholder is Italy's Olivetti, said it had become one of the first US-based manufacturers to conclude a licensing agreement with Apple — a deal that will enable the start-up company to bring Macintosh clones to market as early as the second quarter of 1995. The company was to show off prototypes of its first machines at Macworld in San Francisco, in January.

Power Computing said its computers will run under control of the PowerPC microprocessors and its machines will start below US$1000 for a 66MHz entry level machine.

Power Computing's announcement was not expected until the start of MacWorld. But the company apparently decided to move ahead with an earlier announcement in order to upstage other companies which are also expected to announce Mac clone deals — including another Silicon Valley company, Radius. As many as a dozen companies are expected to announce Mac clone systems during the coming months.

At Apple spokeswoman Jeni Johnstone said power Computing was not the first company to have signed a Mac licensing agreement, although it was the first firm to announce it.

Industry analysts said that while Apple has been late in entering the clone business, the new strategy should allow the firm to double, if not triple to 30% the worldwide market share of Macintosh

computers in the US$80 billion PC market. Apple's marketshare has been stagnant at around 10% almost since the launch of the original Mac in 1984.

Power Computing was founded and is headed by Stephen Kahng, who made big news in the mid 1980's with his first company, Korea-based Leading Edge which at one point became the industry's third largest PC clone maker.

Sony-Philips offer CD-Movie standard

In the battle for control of the future market of CD movies, Sony and Philips have unveiled their version of an industry standard for CDs that will be capable of playing full-length movies.

It is expected that the new generation of high picture quality movie CDs will render VCR tapes obsolete in the movie rental and sale business. But Sony-Philips believe the move will also set off a debate, if not a competitive battle, that could leave consumers just as confused and polarised as in the early 1980's, at the height of the battle between the VHS and Beta video formats.

The Sony/Philips design calls for a disc that will store up to 135 minutes of modestly compressed full-motion video data on 3.7-gigabyte CDs. A rival standard is expected to be proposed in the near future, by a group led by Toshiba and laserdisc leader Pioneer Electronic.

The Toshiba group claims their format offers higher picture quality due to the greater storage capacity of their discs (4.8GB), which requires less data compression than the Sony/Philips format.

The Toshiba group also claims its format has already been chosen by the Hollywood movie industry, which is said to prefer a format with discs that store at least 4.5GB of data.

Industry analysts said they expect the two groups to eventually settle on a common standard. A divided industry would potentially slow down the development of the CD movie industry, including the sale of a new generation of players.

Further delay for Windows 95

Microsoft is doing its best to replace Intel as the PC industry's 'problem child', with the announcement that Windows '95 will be further delayed and is now unlikely to hit store shelves until at least August. This is the fifth time Microsoft has delayed the launch of Windows '95 and the move comes despite Bill Gates' assurances at Comdex that the program would be in stores by June.

Originally, 'Chicago' was scheduled for release in the first half of 1994. In December 1993, Microsoft delayed the launch until the second half of '94. Then in July '94, the release date was pushed back to December. In August it was further delayed to April '95. And finally at Comdex in November, Bill Gates changed the date to June '95.

Microsoft said the latest delay was due to the need to fix some parts of the program to ensure compatibility with software written for earlier versions of Windows. The delay was not due to the discovery of any major flaws in the software.

Industry analysts were quick to point out that Microsoft's dominating position is unlikely to suffer much damage from the latest delay due to the lack of competition in the PC operating systems market. Both Apple and IBM with its OS/2 WARP program may benefit through additional sales, but the increase is unlikely to put a major dent in Microsoft's 80%+ ownership of the PC operating systems market.

However if there are any further delays, Microsoft will have to change the name of its new operating system to Windows '96 to avoid it looking like 'last-year's model' when it hits the streets. Even if Microsoft is able to keep to the newest launch date of August 1995, that means that most buyers won't get their hands on it until 1996 anyway.

In the wake of Intel's Pentium fiasco, one thing is certain: Consumers will not accept a flawed product and companies like Microsoft had better not try ship a critical software product containing any sort of flaw, however minor, without being willing to replace millions of copies. Intel and Microsoft may dominate their markets and roll over any competition, but consumers are not to be taken for granted as Intel learned the hard way.

CHRISTMAS PC SALES SURGE 35%

Consumers in the United States gave the PC industry a largely unexpected bonus, as they put personal computers under their Christmas trees in record numbers.

According to preliminary sales figures released by the Channel Marketing market research firm, Christmas PC sales increased a whopping 35% over last year's holiday season.

Demand appeared to be driven by a number of factors, including low prices and a surging demand for multimedia and on-line services. "You can get a multimedia PC for the same price or less this year, than a non multimedia system a year ago"; said David Goldstein, president of Channel Marketing.

Some 95% of all PCs sold in the US during the holiday season were multimedia capable, with built in CD-ROM drives, sound and advanced graphics capabilities. Half of all PCs sold were built around the Pentium, in a clear indication that the Pentium bug problems didn't scare many buyers away. Compaq and Packard-Bell appeared to be the main beneficiaries of the strong Christmas buying trend.

CD-ROM market explosion continues

The CD-ROM market, including audio, video, interactive, and other formats, has skyrocketed, and applications are beginning to take the market by storm, according to a report from BIS Strategic Decisions. BIS estimates worldwide shipments of CD-ROM drives will total 9.6 million units in 1994, accounting for revenues of US$2.4 billion. The average price of the CD-ROM drive has fallen to just US$250.

In 1995, BIS expects unit sales to grow nearly 30% to 12.8 million drives. And with a projected annual compounded growth rate of 21%, the market will reach annual sales of 31 million units and US$6.2 billion by 2000.

Technology improvements and steady software developments have split the market for CD products into two primary segments: computer-based systems and set-top CD players. The home market has dominated purchases of computer-based products by an estimated 75%. The set-top based CD market is newer than its computer-based peer and is only now taking shape, with products that include the Sega CD, the 3DO Multiplayer, Philips' CD-Interactive and Apple's Pippin-type players. BIS believes that there are and will continue to be opportunities for set-top based applications and products.

"Not every consumer wants the computer to be the delivery vehicle for CD games, movies and music", said Sandra Churchill, BIS consultant and author of *Forecasting the Markets for CD Discs and Drives*. "There is a strong ergonomic argument for television to be the natural medium for entertainment. Also, many people view the family living room as more suitable for multimedia entertainment than the home office computer, which typically sits on a desk in a corner." ❖

NC EASY CONNECT PLUS LINE SHARER

For the last three months, Peter Phillips has been testing a device that allows a fax machine to share the same line as a number of phones. It's not a fax switch, but a high tech device that is claimed to solve most of the problems normally experienced when phones and faxes share a phone line. Here's what Peter found...

Is this like your communications setup? A Telecom phone line with an answering machine at one outlet, a conventional phone on another and a portable phone in parallel with a fax/modem on a third. You've found the fax/ modem so useful that you're thinking of installing a second phone line, to avoid the hiatus caused by someone sending a fax without letting you know in advance. You still haven't figured out what to do when the answering machine doesn't turn off when you've answered the call on another phone. Not to mention the drama of the answering machine responding to a fax, before the computer's fax software gets to it...

What I've described is my own communications setup, which is probably typical of many. So when I had the opportunity to review a device that promised to solve all these problems, naturally I was very interested.

The device I'm reviewing is from Queensland firm National Communications, which makes a range of line sharers under licence from the parent company in the US. I read about their product range from a press release, and decided that if it was as good as it claimed to be, here was something readers would be interested in. After all, if it works, a line sharer is a much cheaper option than installing an extra phone line.

If you're sensing scepticism, you're right. I've

travelled the 'quick fix' road before and have usually found fax switch manufacturers' claims to be of the gambit variety.

When it doesn't work, the explanation is usually that *my* equipment 'isn't compatible'...

Initial problems

When the package arrived, I followed the relatively simple instructions to connect the line sharer. The diagram in Fig.1 shows my phone setup and how I connected the Easy Connect line sharer. Notice that it's powered by a plugpack. As it turned out, most of the problems I was to experience had nothing to do with the Easy Connect. I can lump the reasons into three categories: failing to read the manual, not having the fax software on the computer set up correctly, and those I'll call learning experiences (read 'stupidity').

I mention that I had problems, as although I've been into computer communications for many years, it's an area fraught with many variables. Fortunately the staff from National Communications were very patient, and obviously used to solving the sort of problems I was having. As Managing Director Ron Smith said, "We've seen it all before in the US, so we can bring this experience to Australia".

So now that I've set the scene, here's some details about the product, and what I found after using it for about three months.

The product

The Easy Connect range starts with the Easy Connect Standard, which is for lines requiring automatic detection of incoming fax calls only. Next is the Easy Connect Plus, the device I'm describing here. This product is designed for automatic detection of incoming fax and modem calls, when using a combined fax/ modem. The third device is the Easy Connect Pro,

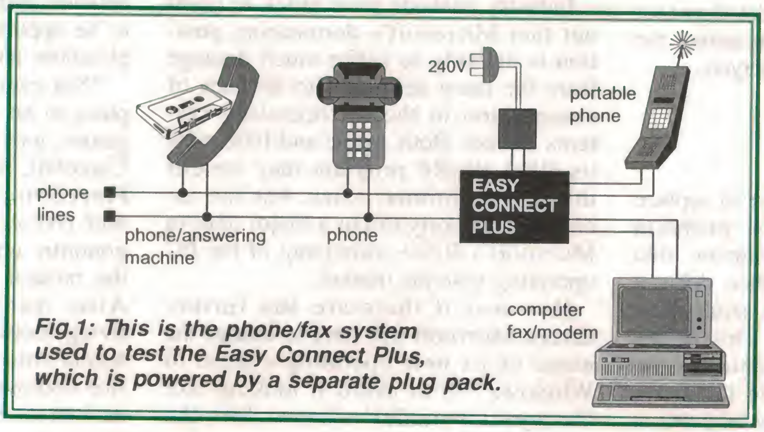


Fig.1: This is the phone/fax system used to test the Easy Connect Plus, which is powered by a separate plug pack.

for separate fax and modem devices.

The unit is a very compact 85 x 95 x 33mm and has four sockets for connection to the plugpack, the incoming phone line, a phone and a fax/ modem. The only other external device is a bank of DIP switches, to select the number of rings before the unit answers a call. However, I missed not having a power-on indicator. The device can be connected at any phone socket and is very easy to connect. I had it installed in less than a minute.

The housing of the device is totally sealed, so I wasn't able to have a look inside. However, I'm told the electronics includes a microprocessor and surge protection circuitry. As well, all the products are Austel approved and come with a two year guarantee.

A line sharer not be confused with a fax switch; a device that's supposed to automatically recognise an incoming call and redirect it to the appropriate device. To explain what the Easy Connect does, we need to look at the three possible scenarios when someone phones your office (or home):

1. When the office is attended. Here, regardless of the nature of the call (voice, modem or fax transmission), when the phone rings, someone answers it. If the call is a fax or modem transmission, hang up and the Easy Connect will transfer the call to the fax/modem. Otherwise, talk as usual.
2. When the office is unattended. Here there are two possibilities: with or without an answering machine. If there's an answering machine, it will answer an incoming call. However, if the Easy Connect detects the CNG tone sent by most fax machines, the call will be redirected automatically to the fax machine (or fax/modem), and the answering machine will be stopped, ready for the next call. Otherwise, a voice call will be stored on the answering machine in the usual way. About the only consideration is to leave a three to four second silence at the start of the answering machine's out-going message, to give the Easy Connect time to detect a CNG tone.

If there's no answering machine, all calls will be transferred to the fax/ modem if a call is not answered after a preset number of rings. The number of rings can be set with the DIP switches already mentioned. This is about the only time a caller will be greeted with fax tones.

These are the three Easy Connect line sharers.

The variables include fax machines that don't send CNG tones (applies to very few), and manually dialled fax machines, which are also becoming increasingly rare. Any call can be manually transferred to the fax/modem by dialling '3' and hanging up.

What we found

The foregoing is what the Easy Connect is supposed to do. But did it? There are still one or two hiccups with my phone system, but overall I can say it's now much more manageable, and even slick. Fax calls and modem transfers come in with no problems, providing the computer software is set to answer these. The answering machine has been tamed and callers are no longer subjected to fax tones and other nasties.

I've had one voice call diverted accidentally to the fax since installing the Easy Connect, but otherwise callers have no idea there's a high tech device listening all the time to every phone call. On rare occasions, the fax software will burst into life at the end of a phone conversation — just after the phone is hung up, but while the calling party is still on the line.

This photo shows the line sharer reviewed here. Access to the four DIP switches is from underneath the unit.

But apart from these rare occurrences, the device has worked perfectly. It's withstood two enormous thunderstorms, both of which caused electrical damage in the neighbourhood. Incidentally, if there's a power failure, the phone plugged into the Easy Connect is still connected to the phone line and can be used normally.

Conclusion

There's no doubt that the Easy Connect Plus line sharer does all it's claimed to. There's nothing you have to do, or to remember, other than making sure the equipment connected to the phone line is properly set up.

The alternative to a line sharer is another phone line, which is hard to justify unless you're getting a lot of faxes. So for people like me, this device is an excellent and relatively cheap way to maximise the use of a phone line. And it's nice to know that the staff behind the product know what they're talking about.

The RRP of the Easy Connect Plus is $329 (incl tax). The Easy Connect Std is priced at $299 and the Easy Connect Pro is $349. Each device comes with all cables, adaptors and a manual.

For more information contact National Communications, PO Box 6473, Gold Coast Mail Centre, 4217 or phone and fax (075) 965 128. Incidentally, although you'll never know, there's an Easy Connect Std line sharer fitted to this number. ❖

NEW PRODUCTS

Digital clamp meter

The model 2017 digital clamp meter from Kyoritsu meets the safety requirements of IEC-1010-1 and UL-1244 and is provided with 600V AC overload protection. It has a shape styled to fit the operator's hand, and the 'tear drop' shaped jaws give easy access to crowded control panels and switchboards.

It has an AC current range of 0.1A to 600A, 33mm jaws, and can measure AC volts to 600V, as well as resistance. It also has data hold. It weighs 400 grams and measures 208 x 9 x 40mm.

For further details contact your nearest electrical wholesaler.

Low cost chart recorder

The Jaquet ECO 951 is a basic no frills single pen, single input, single speed 100mm chart recorder. It can use roll or fan-fold charts with linear scale gradations of 0 - 100%. Standard input is 4 to 20mA, chart speed is 20mm/h.

The recorder can also be supplied with a different (fixed) measuring range, scale gradation, paper speed, damping time and/or power supply. The unit is mounted in a corrosion protected sheet steel housing which ensures good heat removal, long service life, good dimensional stability and perfect grounding and shielding.

For further information circle 241 on the reader service coupon or contact Electromark, PO Box 134, Mortdale 2233; phone (02) 533 3322.

PCB excavation system

The Microchine from Pace is a lightweight, variable speed miniature machining system designed for repair and modification of today's advanced electronics.

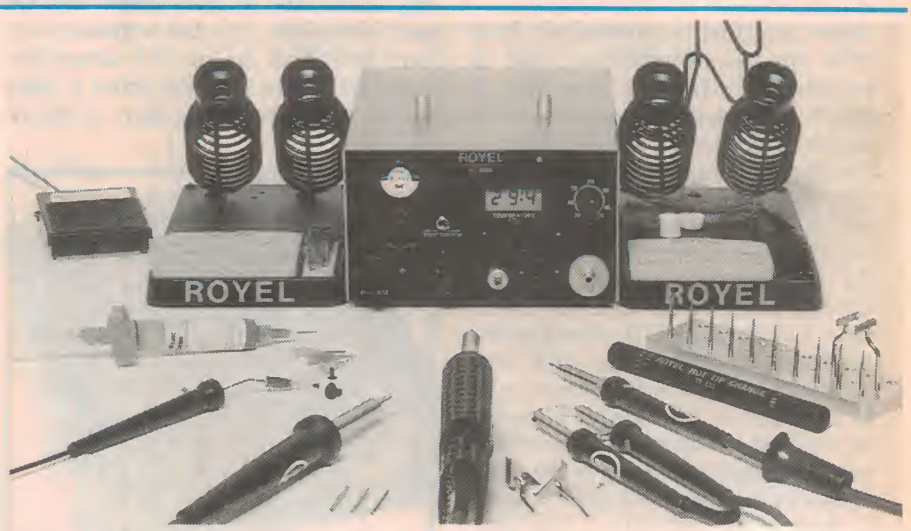
The device has quiet, low vibration operation, and the smooth start integral handpiece motor provides measured acceleration to selected feedback maintains controlled drilling and milling rates under varying loads. Torque limiting cir-

SM rework station

The replacement of surface mounted components, without causing damage to fine tracks and other devices, is a task which is claimed to be up to five times more difficult than replacement of leaded components.

To meet this need, Royel has introduced the RT6550 Universal SMC/PTH circuit rework station, which can remove and replace 80% of surface mounted devices under close tolerance temperature control. This relatively low cost unit incorporates a solder paste dispenser with electronic metering control, built into a power unit with a bench footprint of 170mm x 200mm.

The unit also incorporates a variable temperature digital readout control for a hot jet handpiece, for reflowing solder paste, a lightweight temperature controlled tweezer with replacement tips/heads for surface mount component removal and a vacuum pickup quill for handling the smallest devices. In addition, the power unit can operate precision soldering and desoldering tools for leaded, thru-hole devices.



For further information circle 244 on the reader service coupon or contact Royston Electronics, 27 Normanby Road, Notting Hill 3168; phone (03) 543 5122.

cuitry helps prevent overload damage. Dynamic braking stops machining instantly when the finger switch is released.

For multilayer PCB repair, the probe brake feature allows controlled machining to selected layer depths without damage. Protection of underlying and adjacent conductors makes conformal coating removal and other surface rework safer.

For further information circle 242 on the reader service coupon or contact Solder Static, 262 Miller Road, Villawood 2163; phone (02) 725 6211.

6.5 digit electrometer

Keithley Instruments has introduced a 6.5 digit electrometer, model 6517, that offers a very high accuracy and sensitivity as well as a variety of features that simplify measuring high resistance and the resistivity of insulating materials. The electrometer has full autoranging over all current, resistance, voltage and charge measurement ranges. Its ranges include current measurement from 100nA to 20mA, voltage measurement from 1uV to 200V, resistance measurement from 10 milliohm to 10^{16} ohm, and charge measurement from 1fC to 2uC. A +/-1kV voltage source is included in the instrument.

The electrometer is designed for easy, DMM-like operation via the front panel. It can also be controlled with a built-in IEEE-488 interface. The two-line vacuum fluorescent display allows a number of measurement functions to be displayed simultaneously, e.g., the calculated resistance can be shown along with the source voltage and the measured current. It will also perform the calculations involved in making volume and insulation resistance measurements of printed circuit boards, voltage coefficient testing of resistors and diode leakage.

For further information circle 248 on the reader service coupon, or contact Scientific Devices, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622.

Special Feaure:

PC Enhancements

Colour fax

ColourLink is a software package by Laser Today International, which allows colour documents to be sent by fax. The minimum system requirements are a '486 (or better) PC, DOS 5.0 or later, Windows 3.1 in enhanced mode, 4MB RAM, 14.4kb/s modem (V.32bis, V.42, V.42bis), 1.4MB floppy disk drive, mouse, colour printer (to print received faxes) and a colour scanner (to send colour faxes).

The software allows the user to send full colour images from printed documents (scanned into a computer) or from computer files. The RRP of ColourLink is $795.

For further information circle 205 on the reader service coupon or contact Aries Technology, Unit 1, 138-140 George Street, Hornsby 2077; phone (02) 482 7277.

Development system for 8051 and 68HC11

Ashling Microsystems has introduced a Windows integrated development environment, called WinIDEAS, for the popular 8051 and 68HC11 microcontroller families

The new product provides a uniform interface, under Microsoft Windows, for editing, C-compiling, assembling, fuzzy logic design compilation, linking, in-circuit emulation, performance analysis, code coverage measurement, software validation reporting and EPROM/EEPROM programming.

After debugging a 68HC11 or 8051 microcontroller program using the Ashling Pathfinder for Windows source-level debugger, the designer can immediately return to the WinIDEAS editor, at the appropriate line in the source file, to change the source program. With a single keystroke, WinIDEAS recompiles and re-links the program, downloads it to the in-circuit emulator and resumes debugging at the same line in the source file.

The WinIDEAS programming reference system provides a complete on-line reference manual for the C programming language and the 8051 and 68HC11 instruction sets. By clicking on a word in the source file, the designer can check the correct syntax for a C function or assembly instruction.

For further information, circle 203 on the reader service coupon or contact Metromatics, PO Box 315, New Farm 4005; phone (07) 358 5155.

Four-port serial interface

Advantech has released the PCL-746, a card containing four serial ports that can be configured individually to either RS-232, RS-422 or RS-485 with on-board jumpers.

The card features four 16C550 UARTs, each with on-chip 16 byte FIFO buffers. The card also supports a baud rate up to 115kb/s. It can operate in either standard or enhanced mode. In standard mode, all four ports act as normal PC serial COM1 to COM4 ports, with normal default addresses and IRQs.

In enhanced mode, all four ports can be set to share the same IRQ, which can be any of the most common (extended) AT interrupts. Using RS-485 mode provides efficient communications over long distances. This mode also automatically senses the direction of incoming data and switches its transmission direction accordingly. It can be used with software that supports RS-232. The card is supplied with PCcomLIB software, a programming library for IBM compatible computers.

For further information circle 206 on the reader service coupon, or contact Priority Electronics, Suite 4 & 5, 32-25 Melrose Street, Sandringham, 3191; phone (03) 521 0266.

SCSI fibre optic bus extender

The LazerLink III is a SCSI fibre optic bus extender which overcomes the six metre distance limitation of a single-ended SCSI bus. The SCSI interface is a high speed interconnection media between microcomputers, mini computers and high performance peripherals. With LazerLink III SCSI components can be located up to one kilometre from the host computer.

Features include maximum data transfer rate and support 10MB/s of both SCSI and SCSI-2 specifications. The device is a single-ended SCSI interface, which is user installed. It requires no additional software and features fibre optic data security.

For further information circle 201 on the reader service coupon or contact SCSI Corporation, PO Box 6888, Baulkham Hills 3153; phone (02) 894 6033.

Hayes providing 24-hour support

Hayes Microcomputer Products (Australia) is now providing 24-hour customer support. Customers in Australia can get free online support between 9am and 6pm Australian Eastern Time on the freecall number 1800 809 789 (61 2 959 5544 from New Zealand).

Customers who require assistance after hours can telephone Hayes United Kingdom Customer Support on 44 1252 77 5544 between 6pm and midnight. Between midnight and 9am they can reach Hayes' US Customer Support on 1404 441 1617.

When commenting about the new service, Andrew Phillips, (Country Manager, Australia and New Zealand) said "For the more unusual situations, an internal escalation process will ensure that a problem is handed over to the next Hayes support site at an appropriate level if it is not solved locally, so that a solution could be waiting for the customer the next morning."

Other existing avenues of support include the CompuServe forum (GO HAYES) and Hayes Online BBS at the Freecall number 1800 633 431.

Best known for their microcomputer modems, Hayes also develops, supplies and supports computer communications equipment and software for personal computers and computer communications networks.

JPEG image compression library

MuTech has announced the availability of a comprehensive, JPEG software developers kit for those who need to embed high quality image compression into their applications. MuTech's JPEG-SDK is fully compliant with ISO-10918 and runs under applications written for either DOS or Windows.

Continued on page 122

PC ENHANCEMENTS

With JPEG compression, grey scale images can be compressed up to 10:1 and colour images up to 20:1, with little visual image degradation. A full screen 640 x 480, full 24-bit colour image can be compressed from its original size of 921.6KB to less than 50KB. JPEG ratios of up to 100:1 are possible when image quality is not the primary concern.

MuTech's library is optimised for producing high quality images on an Intel X86 family CPU. The package supports all the file formats commonly used by Windows and DOS programs, including TIF, TGA, BMP, DIB and JFIF. Modes of operation include file-to-file, file-to-VGA display and direct frame grab-to-file.

For further information circle 202 on the reader service coupon or contact The Dindima Group, PO Box 106 Vermont 3133; phone (03) 873 4455.

Frame grabber for PCI bus

MuTech has announced a high performance frame grabber for the PCI bus, the new industry wide standard peripheral bus for high performance desktop computers. The M-Vision 1000 is a complete grey scale imaging system featuring support for variable scan rates RS-170/CCIR cameras and digital cameras, with either 8-bit or 10-bit pixel resolution as well as an on-board video multiplexer which can switch between up to four video sources.

The M-Vision 1000 is targeted at high performance applications in automatic inspection, machine vision, medical imaging, and laboratory image analysis where high quality images need to be captured and transferred quickly.

The analog input system accommodates both standard and non-standard video cameras and digitises with 8-bit or 10-bit resolution. An optional digital camera interface module accepts images directly from the new breed of high performance digital cameras. The M-Vision 1000 includes a special field programmable gate array (FPGA) designed by MuTech engineers, which serves as the interface between the PCI bus and on-board local memory.

For further information circle 204 on the reader information coupon or contact The Dindima Group, PO Box 106, Vermon 3133; phone (03) 873 4455.

Virus detection

The new Virus Buster for Windows (cryptically named B4W) by Leprechaun Software has all the features of the DOS version, with the added advantage of being able to exploit the Windows environment. For example, files, directories and whole disks shown in the Windows File Manager can be dragged onto the B4W icon for virus inspection.

Alternatively B4W will add a File Manager extension which allows a file to be selected and scanned for viruses by picking Scan from the File Manager menu and dragging it onto the extension's icon. Excel, Access and other Windows applications can be checked using DDE. Another feature in the program is a Windows uninstaller, to remove all parts of a Windows application after it's deleted. Another version of B4W, called VB Lite for Windows, is now also available. This program can be set to scan all new diskettes automatically.

For further information circle 207 on the reader service coupon or contact Leprechaun Software, PO Box 826, Capalaba 4157; phone (07) 823 1300.

UPS has longer battery life

The new Deltec PowerServer 30 Series are an online style of UPS featuring dual conversion technology and are available in sizes 2.5, 3, 4, 5, and 6kVA. This latest series is the first in a number of new Deltec releases planned over the next few months.

The PowerServer range has been designed for both industrial and local area network markets. To meet the requirements of both these markets, the UPS comes with a manual maintenance

bypass switch, built in RS-232, voltage free contacts, optional isolation transformer and when used in conjunction with the latest LANSAFE III software, is fully SNMP compliant.

With any UPS system however, no matter what technology is used or how many features are offered as standard, the most important component, and unfortunately the one most likely to fail, is the batteries. To eliminate this weak link, Deltec have incorporated a system called advanced battery management (ABM) into their latest UPS, which assures significantly longer battery life, faster charging and up to 60 days warning when the batteries finally reach the end of their useful life.

For further information circle 208 on the reader service coupon or contact Online Control, 29 - 31 Carlotta Street, Artarmon 2064; phone (02) 436 1313.

Data logger stores 120,000 readings

The new Rustrak Ranger 1200 data logger has 256KB of onboard memory and advanced data compression software. Without data compression, 120,000 readings can be stored.

Continued on page 125

PC ENHANCEMENTS

Continued from page 123

With data compression, the effective storage capacity can often be doubled. Because the logger is microprocessor-based, it can handle unattended recording of up to eight input channels, and is able to perform mathematical calculations on the input data, storing the results in four additional channels. Recordings last from a few seconds to 999 days.

The parameters that the Ranger can store include voltage, current, apparent power, true power, power factor, phase angle, watt hours, VARS, frequency and temperature. Memory capacity can be extended with removable data packs. By using the packs, the data can be removed for analysis, and the logger left recording on site. When data collection is complete, the information can be downloaded to a PC. Pronto software, supplied as standard with the data logger, is used for plotting, analysing, hard copy reporting, and storing data.

For further information circle 243 on the reader service coupon or contact Philips Scientific & Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

SIMM memory tester

From Computer Service Technology, the SP-2000 is a SIMM tester designed for computer dealers and service professionals. The standard SP-2000 tests all popular 30-pin and 72-pin modules and its library supports testing up to 16Mb x 8/9 for 30-pin SIMMs and up to 32Mb x 32/36/40 for 72-pin PS/2 type modules. The tester requires an IBM PC-XT or AT computer.

It offers upgradability for future devices up to 256MB, and with optional adaptors, it also supports a wide range of memories and memory cards, such as the JEIDA 88-pin PCMCIA card and the new 3.3V memory chips and modules. The SP-2000 gives true 5.0V and 3.3V testing, claimed as a breakthrough for the industry. The tester is designed to be easy to use and has pull down menus and help functions to guide a non-technical person through the testing procedure. A complete test can be performed by pressing a single button and test results can also be stored on disk.

For further information circle 249 on the reader service coupon or contact Nilsen Technologies, PO Box 30, Concord 2137; phone (02) 736 2888.

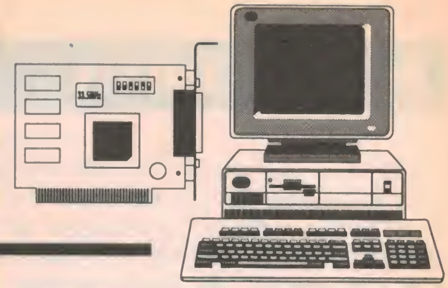
Eurocard prototyping boards

A complete range of prototyping boards, backplanes and extender boards from German Specialist CAB-Produkttechnik, designed for the Eurocard environment, is now available in Australia. The boards come in standard 3U, 6U and 9U heights, and suit the complete scope of the DIN 41612 connector range.

The CAB boards are designed for use with the standard Euro 19" card frame sizes of 160mm and 220mm. A double height square pad board which is 400mm deep, is also available. These boards are suitable for straightforward soldering and wire wrapping techniques making them ideal for initial circuit design and prototyping. The available copper patterns range from single sided straight line tracks, IC patterns with solder pads and quare pad boards, to double sided plated-through hole and colander ground plane boards. All the boards are designed for power distribution through power rails printed on the board. Most are supplied with two planes.

For further information circle 250 on the reader service coupon or contact Ricon, 66-76 Dickson Avenue, Artarmon 2064; phone (02) 439 6078. ❖

Computer News and New Products



Loudspeaker design service

Audio CAD, a design service recently established by Gaby Sikh, caters for individuals who want to design a loudspeaker system, but lack the computer equipment and software.

Gaby established this service after being unable to find a commercial loudspeaker under $5000 that suited his listening tastes. Realising that speaker design required sophisticated computer software, Gaby attempted to find a company that could help him design his own speakers.

This proved difficult, as the few companies who do this are aimed at the professional market. Gaby then purchased the necessary equipment for the task, which is why he can now offer his services in this field.

As a guide, the charges are $30 minimum for any service, and $30/hour for design and measurement work; a basic cabinet design and system response using a driver whose model is in the LEAP library is $45; while a complete driver measurement (SPL, Thiele/Small parameters and impedance) costs $75. A special 50% discount introductory offer is currently available to EA readers (for one month), with an ongoing 10% discount.

For further information cicle 162 on the reader service coupon or contact Audio CAD, PO Box 276, Sans Souci, 2219; phone 580 5634 (after 6pm), or fax (02) 583 1956.

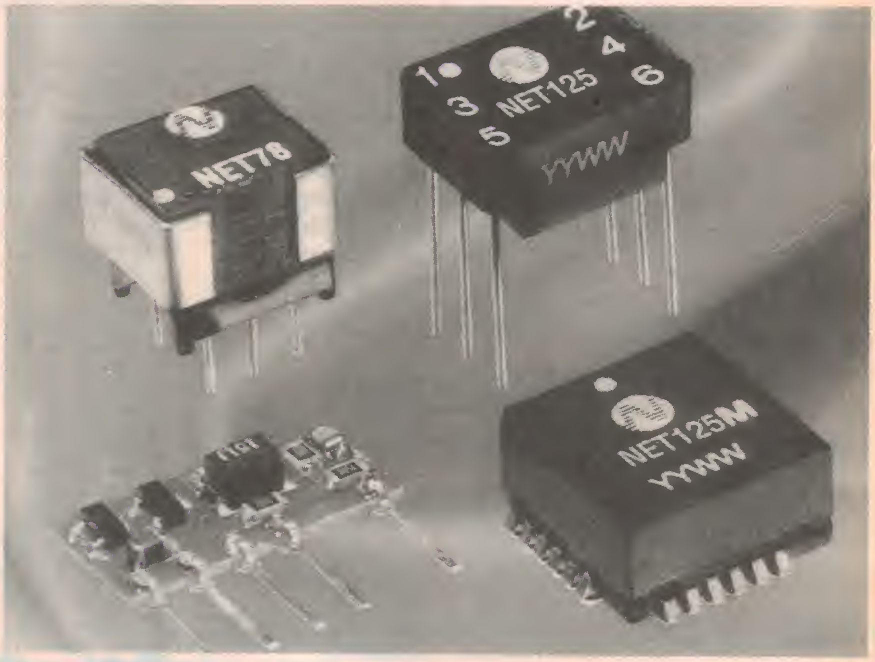
Interface parts for LON networks

A new range of isolated interface components for Echelon local operating networks has been announced by Alpha Kilo Services.

The range includes isolators for twisted pair networks, passive filters and a self-contained isolated RS-485 interface.

The components are claimed to allow a system designer to implement a network interface with a minimal component count. The complete analog front end of the network can be achieved for a variety of network configurations with transmission rates that give compatibility with existing LON systems.

For further information circle 161 on the reader service coupon or contact Alpha Kilo Services, PO Box 475, Artarmon, 2064; phone (02) 901 3770.



RS-232 to RS-485 converter

The new TCG TIC converts the RS-232 serial interface of a PC to the RS-422/RS-485 standard. This gives improved baud rate and distance characteristics, and also allows multiple serial devices to be serviced by a single cable.

TIC is a low cost unit capable of data rates in excess of 38,400b/s, is DCE/DTE selectable, operates in both full or half duplex, and features LEDs displaying line status. The unit is Australian made, comes with user requested male/female RS-232 connectors, plug plack, and screw terminals for ease of connection. TIC retails for $80 (ex tax) and comes with a 90-day warranty.

For further information circle 163 on the reader service coupon or contact TCG Manufacturing, 53 Balfour Street, Chippendale 2008; phone (02) 698 5000.

Portable CD-ROM

Toshiba has announced two new CD-ROM drives. The first XM-3501B, a quad-speed, internal, half-height, 5.25" unit with a random access time of 150 milliseconds, claimed to be the fastest CD-ROM drive in the world. It also features a high sequential data transfer rate of 600Kb/s.

Other features of the drive include x1, x2 and x4 speeds, embedded SCSI-2 interface controller and Photo-CD compliancy. The second CD-ROM drive is the portable double speed XM-4100A, featuring a 300Kb/s data transfer rate, embedded SCSI-2 interface controller, synchronous data transfer and CD-DA transfer over SCSI. Like the XM-3501B, it fully complies with the multimedia PC specifications for CM-ROM and is Photo-CD compiant.

Compact in size and weighing just over half a kilogram, this drive has a shell-type loading mechanism, low power consumption, and uses an AC adaptor. It is suitable for applications such as software distribution, electronic publishing, and extending storage capacity. The XM-3501B has an RRP of $733 (inc tax) while the XM-4100A has an RRP of $577 (inc tax).

For further information circle 164 on the reader service coupon or contact Toshiba Australia on 008 021 100.

Data acquisition modules

ADAM modules are compact intelligent sensor-to-computer interfaces encased in rugged industrial grade PVC packages. Featuring built-in microprocessors, they provide signal conditioning, analog I/O, digital I/O and RS-485 communication.

ADAM modules need two wires to communicate with the computer, using a multidrop RS-485 network. Communication with the host is done through an ASCII-based command/response protocol, letting the modules talk with virtually any computer.

The modules feature an ability to accommodate multiple types and ranges of analog inputs. Selection of type and range is done remotely from the host computer. The modules can be powered by any unregulated power source between 10 and 30V DC. Their industrial grade shells can be DIN-rail or panel mounted and they can be stacked together. Signal connections are made through plug-in screw terminal blocks.

For further information circle 166 on the reader service coupon or contact Baltec Systems, PO Box 107, Paddington 4064; phone freecall 1800 818 097.

Universal device programmer

Sunshine Electronics have added a new universal programmer, the Power-100, to their existing range of device programmers. The programmer is the result of an improved Expro80, which already supports a wide range of devices, and comes with driver software and utilities.

The new unit features a 48-pin device socket to support over 1500 devices, including flash, EPROM, PLD, PAL, GAL, bipolar and serial PROMs, and MPUs. Throught he software provided, programming and testing TTL and CMOS logic, SRAM and SIMM/SIP devices is simplified by a menu system.

SCSI bus repeater

The SCSI Plus bus repeater extends the usual six metre SCSI bus metre limitation up to 12 metres. It is a low cost device that extends the SCSI bus while maintaining the standard single ended SCSI interface. By installing as many as three SCSI Plus repeaters, the user can relocate laser printers, disk drives, CD-ROMs, scanners, tape peripherals, up to a maximum length of 24 metres.

The repeater generates and conditions SCSI bus signals to improve computer and peripheral performance. It eliminates system crashes caused by poor quality SCSI cables, improper device termination or by 'noisy' peripherals. The device is universally compatible and interfaces with personal computers as workstations, mini and mainframes. Installation of the bus repeater is easy as it does not require a device address. It is installed at any point to increase the distance between SCSI devices by an additional six metres. No additional software is required, and power for the unit is provided by a plug-in wall power adaptor.

For further information circle 165 on the reader service coupon or contact SCSI Corporation, PO Box 6888, Baulkham Hills 2153; phone (02) 894 6033.

The Power-100 connects to the parallel printer port of any PC including laptops and notebooks. Alternatively, it can be expanded to standalone use.

For further information and a free demonstration disk, circle 169 on the reader service coupon or contact Baltec Systems, PO Box 107, Paddington 4064; phone freecall 1800 818 097.

Quad speed CD recorder

The new Yamaha CD Expert series compact disc recording system is claimed to be the world's first quad speed CD recorder. The series is Yamaha's third generation CD recorder and can be used with any platform supporting SCSI-2 that operates in 1x, 2x and 4x modes for CD data, text, image and audio applications. The Expert series is ideal for desktop publishing, document imaging, application software distribution, multimedia pre-mastering, information distribution, education, low volume electronic publishing, and data archiving backup.

Yamaha CD-Rs handle all standard compact disc formats with power and precision, including CD-ROM (data only), CD-ROMXA (extended architecture for interleaving data, audio and video), CD-I (interactive, games and education) and CD-DA (digital audio). The Expert series meets an expanded range of applications and offers three recording modes.

For further information circle 178 on the reader service coupon or contact Mitsui Computer, PO Box 234, Frenchs Forest 2086; phone (02) 452 0452.

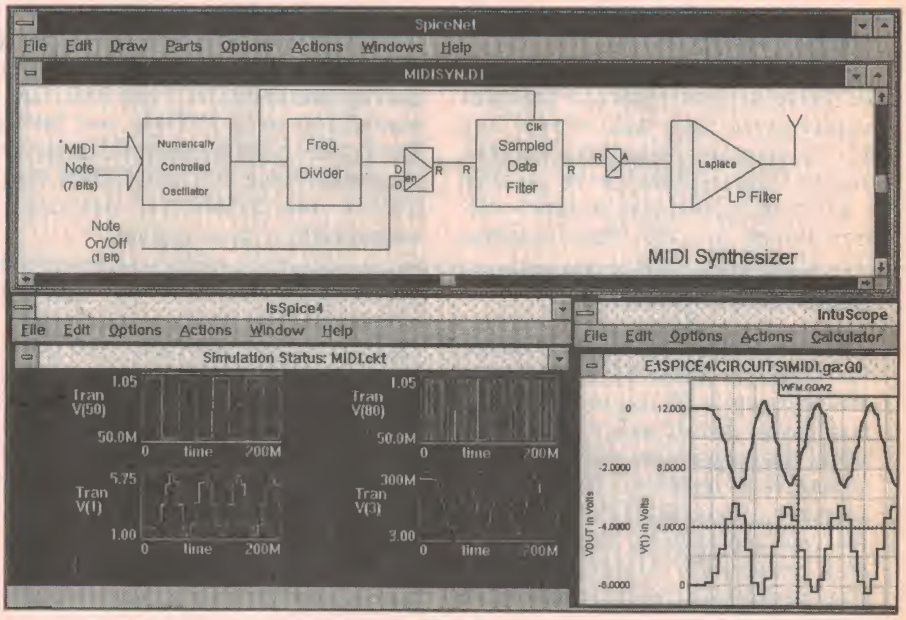
SPICE simulates sampled data filters

The latest version of IsSpice4 has been enhanced with a powerful native mixed mode simulation capability.

Unlike SPICE 3, which is designed mainly for analog simulation and based exclusively on matrix solution techniques, IsSpice4 includes both analog (SPICE 3F) and event driven simulation algorithms in the same executable file. Thus designs that contain significant portions of digital circuitry can be efficiently simulated, together with the analog components.

The event driven algorithm in IsSpice4 is claimed to be unique. It not only supports 12-state digital data, but also other types including real, integer, and a user definable data type. This capability is very useful for simulating DSP functions and sampled data filters in an analog environment.

As an example of this 'multi' mixed mode feature, a MIDI (musical instrument digital interface) synthesiser circuit was simulated by IsSpice4. MIDI is used as a gateway between the analog world of music and the digtal world of computers. The results are



presented in the November 1994 issue of Intusoft's free SPICE Newsletter.

A key aspect of IsSpice4 is that the real data is handled by the event driven simulator. Thus, the sampled data filter is simulated much more quickly than if analog models are used. Models in IsSpice4 are not restricted to one type of data. As in the case of the sampled data filter, both digital and real are used. The circuit simulated in under 10 seconds on a Pentium/90.

For further information circle 170 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2254. ❖

We're the Hakko Iron Specialists!

New! New! New! New! New! New!

HAKKO 808 Portable Desolderer

FEATURES

- *Minimal vibration*
- *Hand held*
- *Adjustable Temperature 380-480°C*
- *Nozzle ground potential difference 2mV or less*
- *Nozzle ground resistance 2Ω or less*
- *With soldering cover included, unit can be stored straight after use.*

NEW!

At last Hakko have produced a hand-held desoldering tool to complement their range of conventional desolderers (parts are interchangeable). Powerful double action pump. Cover removes for easy maintenance. Only filter element needs replacing keeping filter replacement costs down.

$578.95 inc tax

$478.50 tax exempt

Carrying Case C1099 $93.45 inc tax
$77.20 tax exempt

Hakko 926 Soldering Station

The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.
Some people are asking $250!

Our's are only **$199.95**

We keep 18 Hakko Tips in stock plus spare parts, solder etc

SMD Removal Kit for Denon SC7000 and SC5000

- *One touch removal using suction cup*
- *Supplied with 23x17mm head*
- *18 sizes available to order*

$120.95

- *Popular DIC SC7000 still available at $599 inc tax. (DIC Stand $33.85)*

Now Stocking Anti-Static Products

We are now stocking the US-made Richmond Technology range of Anti-Static Products. Anyone dealing with servicing of static sensitive components and circuit boards will be all too well aware of the damaging effects of electrostatic discharge. The Richmond range includes –

Omega-Tech™ Wristband/Cord

Top quality, adjustable, with patented design using a crochet process with 5 silver-plated conductive mono-filaments in a layer of non-conductive nylon yarn. Maximum skin contact and reliable conductivity of inner layer while the outer layer remains non-conductive. 2.5:1 elasticity ratio. Special coiled cord has a high gloss polyurethane coating and is moulded to withstand 20,000 bending cycles without failure. Cam-lock buckle is easy to adjust.
Available with 6ft lead at $28.95
or 12ft lead at $32.95

Field Service Mat

Just what you service technicians have been looking for! Tough long lasting mat features a resilient outer layer that prevents tears and resists punctures and a buried conductive inner layer that guarantees consistent electrostatic discharge. Bound edges for long life. Measures 24" x 24" with two handy 8" x 12" pockets. Supplied with 12ft ground lead and fabric adjustable wrist band.
Why risk expensive equipment when this kit is only $122.95

Static Shielding Bags

You'll need somewhere to store parts so we are now stocking anti-static shielding bags in a range of handy sizes –

150 x 250mm (6" x 10")	$0.75
200 x 200mm (8" x 8")	$0.75
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Due to the great popularity of our 5 part semiconductor catalogue, we are going to include regular listings of our ICs, starting again with logic...

5 Volt Logic

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74AC10PC	Triple 3 In NAND	$0.85
74AC14PC	Hex Schmitt Trig	$1.10
74AC32PC	Quad 2 In OR	$0.80
74AC74PC	Dual D Flip Flop	$1.75
74AC86PC	Quad Excl OR	$1.50
74AC138PC	3/8 Decoder	$1.30
74AC157PC	Quad 2 In Mux	$1.60
74AC174PC	Hex D Flip Flop	$1.25
74AC240PC	Octal Buffer	$3.05
74AC245PC	Tri-St Octal Tcvr	$3.15
74AC373PC	Octal D Latch	$2.60
74AC374PC	Octal D Flip Flop	$2.60

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74HC08N	Quad 2 In AND	$0.95
74HC10N	Triple 3 In NAND	$0.85
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74HC20N	Dual 4 In NAND	$0.80
74HC27N	Triple 3 In NOR	$0.85
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74HC32N	Quad 2 In OR	$0.85
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74HC74AN	Dual D Flip Flop	$1.50
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74HC107N	Dual J-K Flip Flop	$0.70
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74HC123AN	Dual Monostable	$2.45
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74HC153N	Dual 4/1 Mux	$1.15
74HC154N	4/16 Decoder	$1.90
74HC157N	Quad 2 In Mux	$2.25
74HC160N	Preset Dec Ctr	$1.90
74HC161N	Preset Bin Ctr	$1.40
74HC162N	Decade Ctr	$1.00
74HC164N	8 Bit SI PO S/R	$1.15
74HC165N	8 Bit PI SO S/R	$1.95
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74HC174N	Hex D Flip Flop	$1.30
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74HC191N	Up/Down Ctr	$1.55
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74HC195N	Shift Register	$1.30
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74HC237N	3 to 8 Dec/Latch	$1.35
74HC240N	Octal Buffer	$1.75
74HC241N	Octal Buffer	$1.00
74HC242N	Tri-St Tcvr	$1.80
74HC244N	Octal Buffer	$1.90
74HC245AN	Tri-St Octal Tcvr	$1.45
74HC251N	Tri-St 2/1 Mux	$1.40
74HC253N	Dual 4/1 Mux	$1.40
74HC257N	Quad 2 In Mux	$1.15
74HC259N	8 Bit Addr Latch	$1.15
74HC266N	Qd 2 In XNOR	$1.60
74HC273N	Octal D Flip Flop	$1.70
74HC299N	Tri-St 8 Bit S/R	$2.15
74HC354N	Latched Mux	$2.00
74HC356N	Tri-St Hex Buffer	$1.85
74HC373N	Octal D Latch	$1.50
74HC374N	Octal D Flip Flop	$1.60
74HC390N	Dual Decade Ctr	$1.45
74HC393N	Dual Binary Ctr	$1.80
74HC521N	See 74HC688N	
74HC533N	Octal D Latch	$2.40
74HC534N	Octal D Flip Flop	$2.40
74HC540N	Tri-St Octal Buff	$3.00
74HC541N	Tri-St Octal Buff	$2.35
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74HC574N	Tri-St Octal Drivr	$2.40
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74HCT374N	Tri-St Octal Latch	$1.10
74HCT390N	Dual Decade Ctr	$1.70
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74HCT423AN	Dual Monostable	$1.45
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Bipolar Logic

74 Series

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7403N	Quad 2 In O.C.	$0.75
7406N	Hex Inverter 30V	$1.10
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7410N	Triple 3 In NAND	$0.80
7411N	Triple 3 In AND	$0.75
7416N	Offer 7406N	$0.85
7420N	Dual 4 In NAND	$0.75
7421	Qd 4 In AND	$0.60
7423N	Dual 4 In NAND	$0.85
7425N	Dual 4 In NOR	$0.85
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7453N	AND/OR/INVERT	$0.95
7473	Dual J-K Flip Flop	$0.95
7474N	Dual D Flip Flop	$0.95
7476N	DI J-K Preset/Cl	$1.00
7483	4 Bit Adder	$1.50
7485N	4 Bit Comparator	$1.55
7486N	Quad Excl OR	$1.00
7490AN	Decade Ctr	$1.00
7493AN	Binary Ctr	$1.15
7497N	Rate Multiplier	$2.60
74121N		$3.45
74125N	Tri-St Buffer	$1.25
74150N	16/1 Mux	$3.25
74151AN	8/1 Mux	$1.15
74154N	4/16 Decoder	$3.05
74155N	Dual 2/4 Demux	$1.20
74157N	Quad 2/1 Mux	$1.20
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74162AN	Preset Dec Ctr	$1.60
74163AN	Preset Bin Ctr	$1.55
74165N	8 Bit Shift Rgstr	$1.45
74173N	Tri-St Quad Latch	$1.40
74174N	Hex D Flip Flop	$1.40
74180N	Parity Generator	$3.10
74184N	BCD/Bin Convr	$5.75
74190N	4 Bit BCD Ctr	$1.70
74191N	Sync Up/Dn Bin	$1.70
74193N	Up/Dn Bin Cntr	$1.70
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74365N	Tri-St Hex Buffer	$1.10
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GEOFF WOOD ELECTRONICS

Geoff Wood Electronics Pty Ltd and Semtech (inc in N S W)
229 Burns Bay Road, Lane Cove West
N S W 2066 (Corner Beatrice Street)
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27MHz TRANSMITTERS These new Australian made transmitters are assembled (PCB and components) and tested. Xtal locked at 26.995MHz they were designed for transmitting digital information. Their discrete component design uses many components, including 5 transistors and 8 inductors. Circuit provided. Includes heatsink for the output device. Power output from 100mW to a few watts, depending on supply voltage (3-12V DC). These are sold for parts, experimenting and educational purposes. They should not be connected to an antenna as licencing may be needed. **$7 ea or 4 for $20**

BITS & PIECES AT INCREDIBLE PRICES

AX526, AX527 and AX528 ICs. See SC Dec 92, EA Mar 93/94: **$3.50 ea or 10 for $30.**

UHF Rx MODULE, small surface mount receiver module, see SC Dec 92, EA Mar 93/94: **$15**

ULTRASONIC TRANSDUCERS 40kHz TX and Rx transducers plus a 40kHz crystal: **$6**

PIR COMPONENTS KC778 IC one chip PIR detector IC with every feature imaginable, plus a PCB mounted Fresnel lens and dual-element PIR sensor: **$15**

UA3730 IC incredibly versatile combination lock IC plus a keypad to suit: **$12**

8-CHANNEL IR REMOTE CONTROL COMPONENTS Get a range of up to 15m with this 8-channel IR remote control transmitter IC, IR receiver module, 8-channel IR receiver IC, two resonators to suit: **$15**

SM7232 IC continuous dimmer/AC motor controller IC: **$4**

HIGH POWER IR LEDs 880nm, 30mW/12deg @ 100mA: **10 for $9**

DATA or APPLICATION INFORMATION SHEETS for any of these devices are available with the purchase for 60c extra.

CD PLAYER MECHANISMS
Brand new CD mechanisms. include IR laser diode, optics, small conventional DC motor, gears, stepping motor, magnets etc. The whole assembly is priced at less than the value of the collimating lens, which is easy to remove: **$8.50**

$215 CCD VIDEO SECURITY SYSTEM

Monochrome CCD camera totally assembled on a small PCB. Includes auto iris lens. Works with illumination to 0.1 lux and is IR responsive. This new camera is nearly 1/2 the size of the unit previously supplied, almost match box size! Can be used it total darkness with IR illumination: **NEW LOW PRICE $180.**

We can also supply with each camera a used, guaranteed 12V DC green computer monitor and a simple kit to convert it to work with the CCD camera. Monitor **$25**, kit **$10.**

A COMPLETE 12V CCD VIDEO SECURITY SYSTEM FOR $215!!

WELLER SOLDERING IRON TIPS for low voltage Weller soldering stations and mains operated Weller irons. Mixed popular sizes and temperatures. Specify mains or soldering station type: **5 for $10.**

OPTICS

BEAM SPLITTER for 633nm: **$45**

PRECISION FRONT SURFACE ALUMINIUM MIRRORS 200 x 15 x 3mm: **$3.** **LINE GENERATING OPTIC** makes a line out of a laser beam: **$5**

LASER DIODE COLLIMATING LENS: $4. PORRO 90° PRISM gives rainbow from white light: **$10**

PRECISION ROTATING MIRROR ASSEMBLY As used in levelling equipment, needs small motor/belt plus a laser beam, will draw a line right around a room (360 deg): **$45**

LARGE LENS ASSEMBLY Tominon 230nm f4.5 1.7kg symmetrical lens, add an eyepiece ($4) to make a telescope: **$40. PAIR OF LARGE LENSES** two pairs of these are used in the above Tominon lens (0.6kg): **$20. LARGE LENS** out of a night viewer, easily pulled apart: **$18. ARGON MIRRORS** high reflector and output coupler used to make an argon tube: **$50. LENSES:** A pair of lens assemblies from new laser printers. They contain a total of 4 lenses which by different combinations & placement in a laser beam can diverge, collimate, make a small line, make an ellipse etc. **$8.**

HIGH POWER IR LEDs: 880nm / 30mW / 12deg. @ 100mA, **10 for $6**

MAGNETIC CARD READER
Professionally assembled and cased unit that will read information from plastic cards, needs low current 12V DC supply plugpack, **$70.**

MORE ITEMS & KITS

Poll our **(02) 579 3955 or (02) 579 4985** fax numbers for instructions on how to get our item and and kit lists. MANY MANY MORE ITEMS AND KITS THAN THOSE LISTED HERE. *You can also ask for these lists to be sent with your next order.*

FIBRE OPTIC TUBES These US made tubes are from used equipment but in excellent condition. Have 25/40mm dia fibre-optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60 mm long. The 40mm tube has an overall diameter of 80mm and is 92mm long. Their high gain allows them to produce a good image in approximately 1/2 moon illumination, when used with a suitably 'fast' lens, but they can also be IR assisted to see in total darkness. Our HIGH POWER LED IR ILLUMINATOR kit, and the IR filter are both suitable for use with these tubes. The superior resolution of these tubes makes them suitable for low light video pre-amplifiers, wild life observation, and astronomical use. Each tube is supplied with a 9V powered EHT power supply kit. INCREDIBLE PRICES: 25mm intensifier tube and supply kit **$120.** 40mrn intensifier tube and supply kit **$180.** We also have a good supply of the same tubes that may have a small blemish (not in the central viewing area). Blemished 25mrn or 40mm intensifier tube and supply kit **ON SPECIAL $50.**

IEC EXTENSION LEADS: 2m, IEC plug one end, IEC socket other end, **$5.**

EPROMS: 27C512, 512K (64K x 8), 150ns access CMOS EPROMs. Removed from new equipment, need to be erased, guaranteed, **$4.**

VIDEO TRANSMITTERS low power PAL standard UHF transmitters. Have audio and video inputs with adjustable levels, a power switch and a power input socket: 10-14V DC/10mA operation. Enclosed in a small metal box with an attached telescopic antenna. Range is up to 10m with the telescopic antenna supplied, but can be increased to approximately 30m by the use of a small directional UHF antenna. INCREDIBLE PRICING: **$25.**

12V FANS: Brand new 80mm 12V 1.6W DC fans. IC controlled, with four different approval stamps, **$10 ea. or 5 for $40.**

TDA ICs/ TRANSFORMERS We have limited stock of some 20 watt TDA Hi-Fi quality monolithic power amplifier ICs: less than 0.01% THD and TIM distortion, at 10W RMS output! With the transformer we supply we guarantee an output of greater than 20W RMS per channel into an 8 ohm load, with both channels driven. We supply a far over-rated 240V 28V/80W transformer, two TDA1520 ICs, and two suitable PCBs which also include an optional pre-amplifier section (only one additional IC), and a circuit and layout diagram. The combination can be used as a high quality Hi-Fi stereo/guitar/PA amp. Only a handful of additional components are needed to complete this excellent stereo/twin amplifier! Incredible pricing: **$25.** For one 240V-28V (80W!) transformer, two TDA1520 monolithic Hi-Fi amplifier ICs, two PCBs to suit, circuit diagram and layout. Additional components and a heatsink are required.

GAS LASER SPECIAL We have a good supply of some He-Ne laser heads that were removed from new or near new equipment, and have a power output of 2.5-5mW: very bright! With each head we supply a 12V universal laser power supply kit for a ridiculous TOTAL PRICE of: **$89**

BIGGER LASER We have a good, but LIMITED QUANTITY of some 'as new' red 6mW+ laser heads that were removed from new equipment. Head dimensions: 45mm dia by 380mm long. With each head we include our 12V Universal Laser power supply. BARGAIN AT **$170** (6mW+ head & supply ITEM No. 0225B.) We can also supply a 240V-12V/4A 5V/4A switch mode power supply to suit for **$30.**

12V-2.5W SOLAR PANEL SPECIAL
These US made amorphous glass solar panels only need terminating and weather proofing. We provide terminating clips and a sheet of glass. The terminated panel is glued to the backing glass, around the edges only. To make the final weatherproof panel look attractive some inexpensive plastic L angle can be glued to the edges with silicone glue. Very easy to make. Dimensions: 305x228mm, Voc: 18-20V, Isc: 250mA. SPECIAL REDUCED PRICE! **$20 ea. or 4 for $60.** Each panel is provided with a sheet of backing glass, terminating clips, isolating diode and instructions. A very efficient switching regulator kit is also available: Suits 12-24V batteries, 0.1-16A panels, **$27.** Also available, a simple and efficient shunt regulator kit, **$5.**

LIGHT MOTION DETECTORS Small PCB assembly based on a ULN2232 IC. This device has a built-in light detector, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness: With IR LED. Full information provided. The IC alone is worth $16! OUR SPECIAL PRICE FOR THE ASSEMBLY IS: **$5 ea** or **5 for $20**

SWITCH MODE POWER SUPPLIES:
Mains in (240V), new assembled units with 12V - 4A and 5V - 4A DC outputs, **$32.**

KITS

4-CHANNEL UHF REMOTE CONTROL KIT: Two transmitters and one receiver, **$96.**

GARAGE DOOR - GATE REMOTE CONTROL KIT: Tx **$18,** Rx **$79.**

1.5-9V CONVERTER KIT: $6 ea. or 3 for **$15.**

LASER BEAM COMMUNICATOR KIT: Tx, Rx, plus IR laser, **$60.**

VISIBLE LASER DIODE KIT: A 5mW/670nm visible laser diode plus a collimating lens, housing and an APC driver kit (Sept. 94 EA) UNBELIEVABLE PRICE: **$35**

ELECTRIC FENCE KIT: PCB and components, includes prewound transformer, **$40.**

PLASMA BALL KIT: PCB and components kit, needs any 240V light bulb, **$25.**

MASTHEAD AMPLIFIER KIT: Two PCBs plus all on-board components: Low noise (uses MAR-6 IC), covers VHF-UHF, **$18.**

BRAKE LIGHT INDICATOR KIT: 60 LEDs, two PCBs and ten resistors, makes a very bright 600mm long, high intensity red display, **$30.**

MOTOR SPECIAL: These motors can also double up as generators. Type M9: 12V, I no-load = 0.52A - 15,800 RPM at 12V, 36mm dia, 67mm long, **$5.** Type M14: made for slot cars, 4-8V, I no-load = 0.84A at 6V, at max efficiency I = 5.7A - 7500 RPM, 30mm dia, 57mm long, **$5**

POLYGON SCANNERS: Precision motor with 8-sided mirror, plus a matching PCB driver assembly. Will deflect a laser beam and generate a line. Needs a clock pulse and DC supply to operate, information supplied. SPECIAL REDUCED CLEARANCE PRICE **$15.**

EHT POWER SUPPLY; Out of new laser printers, deliver –600V, 7.5kV and +7kV when powered from a 24V-800mA DC supply, enclosed in a plastic case, **$16.**

OATLEY ELECTRONICS

PO Box 89, Oatley NSW 2223

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